REVIEW OF THE DIVISION OF COMPUTING AND COMMUNICATION FOUNDATIONS OF THE NATIONAL SCIENCE FOUNDATION

For the Reporting Period FY 2006-2008

In compliance with the three-year review requirement, the National Science Foundation Division of Computing and Communication Foundations (CCF) convened a Committee of Visitors (COV) for two days—March 4-5, 2009—at NSF headquarters in Arlington, VA. The COV was composed of selected senior researchers in relevant specialty fields and was chosen to span the scientific purview of the CCF Division. During the two-day meeting, the COV reviewed a considerable amount of information about the CCF Division, including past COV reports and CCF responses, and heard presentations from CCF personnel. The COV also reviewed information about each of the three CCF Division Clusters and heard presentations from Program Directors and staff in each of these Clusters. This report provides details of the review of the CCF Division that resulted from the COV meeting. Section 1 gives the Committee Report, which provides an overview of the Committee findings. Section 2 contains the three Cluster Reports, each of which provides details of the findings for that Cluster. Section 3 contains several Appendices, which provide additional information about the COV and the COV meeting.

Section 1: Committee Report

The Committee of Visitors (COV) review was guided by a series of questions presented by the Division of Computing and Communication Foundations (CCF) (see Appendix 3) that focused the COV's considerations. The COV review found that the CCF is dedicated to meeting its goals and to serving its intended research community. The COV also found that, overall, the CCF Division is working extremely well, and that aspects in which improvements could be made or processes reconsidered are minor.

This section consists of two parts: Executive Summary and COV Process. The Executive Summary gives an overview of CCF and presents some trends in CCF during the review period. The Executive Summary then provides overall observations and recommendations that the COV believes need attention and that apply to all three Clusters; other observations and recommendations, specific for individual Clusters, are discussed in the Cluster Reports (Section 2). The COV Process provides information about the COV membership and gives a detailed view of the process followed during the COV review. The COV Process then presents some recommendations to improve future COV reviews.

A. Executive Summary

1. Overview of the Division of Computing and Communication Foundations CCF

See CCF self-study report in appendix.

2. Trends and Statistics

See CCF self-study report in appendix.

3. Observation and Recommendations

Organization: Overall, the COV strongly endorses the reorganization of CCF into the three new clusters: Algorithmic Foundations, Communication and Information Foundations, and Software and Hardware Foundations. In particular, the COV believes that this may address an issue that challenged CCF for many years, which is that the Theory of Computing area was interpreted rather narrowly. The COV believes that the new organization of CCF by three broad themes would enable a broader view of foundational research in computing, information processing and communications. At the same time, the COV wishes to raise some concerns it has about this new organization:

- The EMT (Emerging Models and Technologies) communities (bio, nano, quantum) are rightly concerned about the elimination of EMT as an area. A series of recent (fall 2007 through summer 2008) NSF-sponsored workshops in these areas issued reports emphasizing the need to maintain the cohesion and integrity of these communities. The COV believes that even if each program element would end up being supported by some NSF program, the loss of cohesion and integrity would not be beneficial to these

areas. The COV recommends treating each of the EMT areas as a crosscutting area. In fact, the COV was told that to a large extent this program did function as a crosscutting program, drawing funding from several NSF directorates and divisions, though the data do not seem to support this claim. Formalizing this would ensure that these emerging areas do indeed attract broad support in NSF.

- While the organization of CCF into three broad foundational areas is logical, it makes it difficult to assess the health of the CCF portfolio. The reality is that this portfolio consists of several areas and subareas. The COV recommends that CCF develop a way to monitor its portfolio, including number of submitted proposals and success rates, in an area-based manner. As an example, COV members pointed out that CCF today is the only NSF program that supports architecture research. It is crucial that CCF be able to monitor its ongoing support for this important research area. COV members also pointed out that the area of communications and signal processing research is quite unique in CISE, since this community is typically housed in electrical-engineering departments rather than computer-science departments. To make sure that CISE does not become too computer-science-centric, it is important that the CISE Advisory Committee includes representatives of this community.

- The COV wishes to point out that while it was able to review the three old clusters of CCF: TF, CPA, and EMT, it was not able to review the crosscutting programs that CCF was involved with. The sample of jackets presented to the COV did include some jackets from crosscutting programs, but the COV was not able to obtain an overview of the overall health of these programs. This COV believes that other COVs, reviewing other CISE divisions, would face the same challenge. At the same time, crosscutting programs have become a significant part of CISE's activity. They form a significant part of CISE's portfolio, they consume a significant part of the PDs' time, and they have challenges that are unique to crosscutting programs. The COV believes that CISE needs to develop a mechanism to evaluate its crosscutting programs, either by convening a special COV for cross cutting programs or by providing COVs with detailed data on the participating of reviewed divisions in crosscutting programs.

Success Rates and Grant size: Following the collapse of funding success rates in CISE during 2004-2005, CCF made a concerted effort, with considerable success to improve funding success rates. While aggregate success rates are now at or above NSF's average success rates, the COV is concerned that the aggregate statistics hides some problem areas. For example, the success rate in software research seems to be around 15%, while the aggregate success rate in CPA is above 20%. While the COV does not believe that uniform success rates are feasible or desirable, monitoring success rates area by area is crucial to a realistic assessment of CCF's portfolio, as argued above. It is also important to monitor award size relative to requested budget (see below) by area, rather than in the aggregate across all of CCF.

The data presented to CCF about grant budget cuts by PDs seem to indicate that one way that success rates were improved was by imposing fairly drastic cuts on grant budgets. These cuts seem to have been imposed by the desire to fit as many funded proposal as possible into a tight

budget, in spite of the potentially adverse impacts. From a PI's perspective, the budget is measured not in dollars but units of "effort": months of summer support, graduate students supported, postdoctoral students supported, and the like. The COV recommends that CCF develop guidelines for proposal budgeting, which would be effort-based, rather than dollar-based, as cost structures vary tremendously between different institutions. For example, a guiding principle could be "A small proposal should include one summer-month support, one graduate student supported, and a nominal amount of other direct costs." Such guidelines should be shared with the CCF community as much as possible. Of course, PIs should be able to step outside these guidelines as long as the requests are explicitly justified.

The COV also wishes to express the concern that CCF has slid into providing "incremental funding for transformative research." While support at the level of "one month, one student" may be adequate for some research areas, it may not be adequate for those proposals aiming at ambitious experimental research, which may require the development of large systems, the development of hardware devices, and the like. Such projects may require multiple graduate students, postdoctoral students, or research programmers. PIs should be able to request additional resources. Such requests should be reviewed not only on their intellectual merits and broader impact, but also on the fit of the resources requested to the proposed research. The desire to improve funding success rates should be balanced against CCF's mission of funding ambitious research. The introduction of the "medium" and "large" proposal categories was a good step in this direction.

The COV noted lack of consistency in the budgeting of collaborative proposals. The impression is that proposals where both collaborators are in the same institution undergo more severe budget cuts than collaborative proposals where the collaborators are in different institutions. The COV recommends for CISE to develop consistent guidelines for the review and budgeting of collaborative proposals.

Finally, the COV wondered whether PIs are responding to the reduced budgets by submitting more proposals, which increase the burden on the PIs, the reviewer pool and the NSF staff. That would imply that the end result is simply increased workload for PIs, reviewers, and PDs. The COV recommends for CISE to initiate a study of funding per PI (rather than per proposal) to assess the level of support it offers its research community.

Review Process: Overall, the COV believes that the review process is excellent and results in high-quality funding decision making. It is also clear from the jackets that the PDs do not shy away from exercising their discretion and judgment in pursuing high-risk high-payoff proposals. At the same time, the COV is concerned about the lack of formulated guidelines for the review process. The COV recommends for CCF to engage the community in the development of guidelines for proposal review. This could be implemented, for example, by developing a more detailed template for reviews, asking the reviewer to answer some more specific questions rather than the very broad questions that reviewers have to answer today. The process of selecting and reviewing proposals is analogous to the process of reviewing and selecting papers submitted to research conferences. The computer-science community has a tremendous amount of experience in reviewing and selecting conference papers, and CCF should learn from best –practices in that area. For example, see http://wiki.usenix.org/bin/view/Main/Conference/CollectedWisdom. A specific good practice is to ask reviewers to make constructive suggestions, which would help PIs improve their proposals.

Reading the reviews in the jackets, it is quite clear that CCF reviewers are struggling with finding an appropriate scale on which to rate proposals. Reviewers start by using the standard NSF scale of Poor to Excellent, but then switch to the Not Competitive to Highly Competitive scale. It is not clear, however, whether the latter scale is a quality scale or is a scale of funding recommendations. Some PDs treat it as the former, while some treat it as the latter. The COV recommends for CCF to go back to using a quality rating scale that is completely separate from funding decisions, and to standardize this across programs. Since the Poor to Excellent scale is NSF's standard scale, this should be the scale used by CCF, while making an effort to educate reviewers on how his scale is used across NSF.

While FastLane has evolved into a highly usable system for proposal and report submission, it falls short as a proposal-review system. The COV was struck by its comparison of FastLane to state-of-the-art conference and journal management software. The importance of a more detailed review template was already mentioned above. Equally important is the ability of the software to treat conflicts-of-interest and reviewers' expertise and preferences, to combine panel reviews with ad-hoc reviews, and the like. CISE is unique among NSF's directorate in its familiarity with state-of-the art software tools. The COV recommends for CISE to work with NSF's management on the development of better software support for the review process.

While all PDs demonstrate dedication and passion for CCF's mission and program, there is significant variance in their experience. This is quite visible today, when the majority of PDs are rotators. While the rotators bring fresh perspectives and new ideas, they serve usually fairly short terms and face a steep learning curve. While NSF does a good job of training PDs to work out the mechanics of its work, imparting wisdom is more difficult. The task of moderating panels of diverse strongly opinionated reviewers and bringing them to a consensus is a challenging one and defies formulaic approaches. The COV recommends for CCF to consider developing a "PD handbook" that attempts to capture the collective experience and best practices of its PDs. Experienced PDs have developed a set of principles that guide their work; the handbook would be a tool for them to share their experience. State-of-the-art collaboration tools, such as Wikis, could be used to collectively develop this "handbook". CCF should also provides its PDs with resources to stay connected with their research communities, for example, by regularly attended major conferences in their research areas.

The issue of PD workload is intimately connected to the quality of the review and decision-making process. The COV was provided some data to assess PD workload, but it was insufficient because it did not account for cross-cutting proposals. Our impression is that PD workload has increased dramatically without providing PDs with the software tools they need to manage that increased workload. The COV recommend for CISE to develop tools for tracking and monitoring PD workload.

While CCF is generally able to assemble high-quality panels, invitations to panels often come fairly close to panel meetings. (Some members of the COV recalled being invited to serve on a panel on a one-week notice!) This makes it quite difficult for many people to accept invitations to serve on panels. The COV recommends for CCF to find ways to address this issue. One idea that we mentioned was for CCF to schedule now the panels for 2010 and announce the dates to the community.

While the COV understands the rationale for consolidating submission deadlines, concerns were expressed about the fact that most PIs will now only have one opportunity per year for the core program. In some area, the deadline is fairly close to the submission deadline for their

major conference, making it very challenging for PIs. There is also a concern that the consolidated deadlines would make it very challenging to assemble high-quality panels. The COV recommends for CCF to weigh carefully the advantages of consolidated deadlines against their disadvantages. For example, the deadlines for small, medium, and large proposals can be spread out around the year. Constraints on the number of proposals allowed to be submitted by a PI, could be formulated to an annual basis, rather than per deadline.

The COV noted that CISE has implicitly decided not to use renewal grants, even though these are listed as options in the PGP. The COV recommends for CISE to make explicit its implicit rules. If CISE decided not to use renewal grants, it needs to let the community knows this.

B. COV Review Process

COV Process: The COV commends CCF on its preparation of the Self Study, which was more through than the previous self Study and gave the COV an in-depth view of CCF. At the same time, the COV struggled with answering some questions in the report template for lack of adequate data. The COV recommends for CISE to accompany each question in the template with guidance to the COV on where to find information to answer the question. For many of the questions, for example, quality of reviews, the COV can arrive at an answer by going through the sample jackets. Many questions, however, require aggregate data. While a lot of data was available for us in the self-study, we had to request more data a day before the meeting and during the meeting. The COV believes that the Self Study should be more comprehensive and enable answering all questions that require aggregate data.

In two areas the COV believes that better data is required. A standard technique in conference paper review and selection is to ask reviewers to self-assess their expertise. Such self-assessment is typically fairly accurate and improves the review process.
The COV recommends for NSF to adopt this practice. The COV also believes that proposals that are handled in a somewhat nonstandard way deserve special attention by the COV. This includes proposals that were handled via ad-hoc review rather than a panel review, proposals where the PF overturned a panel's recommendation, or where the DD did not concur with the PD. Right now the only way to identify such proposals is by relying on PDs' memory. The COV believes that NSF should improve its data collection to enable easy identification of such proposals. Another area where data collection needs to be improved is in co-funding of awards across PDs and across programs, as inter-disciplinary research is often funded in such a way.

Openness: Many COV members noted the difficulty of obtaining copies of funded proposals. While project summaries are public documents, the status of the full proposal is not clear. An argument can be made for making proposals publicly available, perhaps after some redaction, after the project is concluded. The COV recommends for NSF to start a conversation with the research community on this issue.

Section 2
Cluster Reports

Each of the COV subcommittees reviewed one cluster, and completed the Report Template for that cluster. This section provides the Cluster Reports for the three CCF clusters: Foundations of Computing Processes and Artifacts Cluster (CPA), Emerging Models and Technologies for Computation Cluster (EMT), and Theoretical Foundations Cluster (TF).

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2009 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2009 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2009. Specific guidance for NSF staff describing the COV review process is described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) that can be obtained at <www.inside.nsf.gov/od/oia/cov>.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the results generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals.

Many of the Core Questions are derived from NSF performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several sub-activities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the sub-activities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

Suggested sources of information for COVs to consider are provided for each item. As indicated, a resource for NSF staff preparing data for COVs is the Enterprise Information System (EIS) –Web COV module, which can be accessed by NSF staff only at http://budg-eis-01/eisportal/default.aspx. In addition, NSF staff preparing for the COV should consider other sources of information, as appropriate for the programs under review.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the ***processes*** related to proposal review; and (B) the quality of the ***results*** of NSF's investments that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the

future. Discussions leading to answers for Part A of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. *COV reports should not contain confidential material or specific information about declined proposals***.** Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. The reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. Since material from COV reports is used in NSF performance reports, the COV report may be subject to an audit.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see http://www.nsf.gov/od/oia/activities/cov/covs.jsp.

FY 2009 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)
Foundations for Computing Processes and Artifacts Cluster (CPA)

Date of COV: 3/4/09 – 3/5/09
Program/Cluster/Section: CPA
Division: CCF
Directorate: CISE
Number of actions reviewed: **Awards:** **Declinations:** **Other:**
Total number of actions within Program/Cluster/Division during period under review: **Awards:** **Declinations:** **Other:**
Manner in which reviewed actions were selected: Random sample augmented with oversampling of proposals with special characteristics such as infrastructure and education proposals, proposals in program areas with a small total number of proposals, and proposals where the PO recommendation or final decision differed from the panel recommendation.

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process. Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[1]
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?	
Comments: Based on our review of the jackets provided to us, discussions with the program directors, and our own experience as both panelists and investigators, we feel that the panel review system combined with program director discretion and the use of *ad hoc* reviews is extremely effective. As one committee member put it: like democracy, the system may appear messy, but it is far better than alternatives. Site visits appear to be used only by large programs that are typically cross-cutting (e.g., Expeditions) and consequently, we did not have the opportunity to evaluate their effectiveness. We did feel that there were some significant opportunities for improvement in the systems for recording and tracking information about proposals, potential panelists, and awards and that NSF would be well served to invest in better IT support to help reduce the load on program directors for administrative tasks. Most journals and conferences now use submission management systems with better support for tracking topics and conflicts amongst potential referees, and for supporting the sorts of queries that would help NSF program directors evaluate the balance of the portfolio. Furthermore, many journals have developed databases with information, such as areas of expertise, which make it relatively easy to find good reviewers. An NSF database of reviewers would also make it easier to track demographic data regarding panelists as the information could be entered once instead of each time a panel is run. Note that, as with the previous COV, we do *not* recommend a shift from Fastlane to Grants.gov, but rather, better tool support for program directors.	

[1] If "Not Applicable" please explain why in the "Comments" section

2. Are both merit review criteria addressed

In individual reviews?
In panel summaries?

In Program Officer review analyses?

Comments:

In almost all cases, the individual reviews address the merit review criteria, and almost all of the summaries do so as well. However, there still seems to be some confusion for reviewers (as well as PIs) regarding the intent and role of "broader impacts". We note that the Grants Program Guide attempts to give guidance and examples, but that perhaps reviewers and PIs would be better served by having concrete questions, similar to those asked on final reports, to help guide their response to this merit criteria.

Some members of the committee felt that with respect to key aspects of broader impact, such as outreach, education, and diversity, CISE should strive to play a leading role in helping the community formulate a set of shared standards and goals. For example, CISE leadership could work with organizations, such as ACM, NCWIT and CRA, to highlight projects that have developed innovative approaches to integration of outreach and diversity with research.

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals?

Comments:

The committee found a high variance in the responses by individual referees. Some referees gave detailed comments while others made only brief remarks. Fortunately, almost all jackets we examined had 4 or more reviews, and out of the 4, a significant fraction included sufficient detail to explain the decision of the panel.

Nevertheless, we see opportunities for improvement. For instance, we noted that reviewers have a tendency to draw out negative aspects of the proposal while leaving the positive properties implicit. We suggest better guidelines that induce reviewers to make a succinct, explicit list of strengths and weaknesses in the proposal, and that they

consider providing better feedback regarding changes to the proposal that might make it more competitive.

We also feel that clearly separating a quality rating from a recommended funding decision would help improve the dialogue on panels.

4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?

Comments:

Yes.

Summaries are a highly important part of any jacket as they draw out the key elements of the individual reviews, reflect what happens in the panel meeting, and are the first place that everyone, from PIs to program directors, to committees of visitors look for information. In general, we found the summaries played these roles well.

5. Does the documentation in the jacket provide the rationale for the award/decline decision?

(Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.)

Comments:

Yes.

The committee was particularly impressed with the documentation for proposals where funding decisions seemed to contradict the recommendations of the panel. For example, in one case we reviewed, the panel marked a proposal as “recommended” but not “highly recommended” yet the program director chose to fund the work. The documentation revealed that one of the PIs was from an EPSCOR state which helped justify the decision. The detailed analysis of the panel reviews also helped justify why this particular proposal was strong enough to warrant funding.

6. Does the documentation to PI provide the rationale for the award/decline decision?

(Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.)

Yes.

Comments:

7. Is the time to decision appropriate?

Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals.

Not quite, but clearly improving.

Comments:

Based on the data given to us, the average dwell time was around 6.5 months for the 2005-2008 CPA proposals. Awards that were declined were processed on average in 6.2 months and those accepted an average of 8 months. We note that the average dwell time improved dramatically for awarded proposals between 2005 (9.5 months) to 2008 (7 months).

However, the percentage of proposals processed within 6 months does not quite reach the NSF goal of 70% within CPA. In 2006, only 47% of proposals were processed in 6

months, but in 2007 this improved dramatically to about 65% and in 2008 to about 58%. (Only a very small fraction of proposals took more than 9 months to process throughout the period.) More importantly, we do not see how these times can be further compressed without significant increases in staff and significant investment in IT systems.
8. Additional comments on the quality and effectiveness of the program's use of merit review process:

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[2]
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: In almost all cases, yes. In fact, most of the committee was pleasantly surprised at the (perceived) high quality of the reviewers given the constraints program directors have due to workload, timing, conflicts of interest, balancing the committee, etc. There were a few cases where we did not recognize the referees. In some cases, they gave excellent reviews, and in others, they seemed to be unfamiliar with the reviewing process (perhaps because they were from industry). We note, however, that this evaluation is based purely on our ability to "name recognize" the panelists. We echo the previous COV in calling for reviewers to provide an explicit indication of their expertise for the area of the proposal (i.e., Expert, Very	

[2] If "Not Applicable" please explain why in the "Comments" section

Familiar, Familiar, Not at all Familiar, etc.)

We also think that the job of finding suitable panelists in a short time frame is a daunting task. The committee suggested that NSF should invest in a database for potential panelists that records areas of expertise, and that lets program directors quickly determine conflicts with submitted proposals. We also suggest that NSF continue to experiment with other ideas that will allow program officers to assemble panels in a timely fashion. For example, if a panel date is fixed in advance, then the office might send a letter to potential panelists well in advance (i.e., three months) so that they can mark their calendars. Again, IT support for doing this task would be necessary to avoid creating more workload on program directors.

Finally, the committee suspects that there will be increasing pressure to seek alternatives to the "in-person" panel system, due to travel costs, a desire to cut the "carbon footprint" of panels, or to seek high quality panelists that cannot participate due to the time and expense of traveling to Washington. We think that NSF should continue to experiment with innovative ideas, such as electronic meetings, but at all costs, preserve the key elements of the panel process. For instance, with panels, there is a real sense of "group work" and group decision making that deepens everyone's initial understanding and leads to a view of each proposal that no individual would have reached on their own. Additionally, panel members collaborate to write summaries that capture the full range of discussion and to synthesize findings from individual reviews. And, the "peer pressure" that arises from in-person evaluation of reviews help strengthen the feedback given to PIs.

2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups?

Note: Demographic data is self reported, with only about 25% of reviewers reporting this information.

Difficult to tell.

Comments:

With respect to type of institution and underrepresented groups, we were unable to tell from the reported data, since so few of the panelists provided responses. We suggest that NSF consider ways to communicate why this information is important.

With respect to geographic balance, we felt that the panels were well balanced in the sense that every state was represented. Of course, those states with leading institutions and expertise (e.g., California) as well as those in close proximity to Washington (e.g., Maryland) had a large presence, but this is to be expected.

3. Did the program recognize and resolve conflicts of interest when appropriate?

We believe so.

Comments:

We did not see instances of conflicts of interest. Clearly, the program officers did an excellent job pre-screening potential conflicts in spite of the fact that they must largely do this by hand.
Additional comments on reviewer selection:

A.3 Questions concerning the resulting portfolio of awards under review.
Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	**APPROPRIATE, NOT APPROPRIATE[3], OR DATA NOT AVAILABLE**
1. Overall quality of the research and/or education projects supported by the program. Excellent. Comments: We found the overall quality of the research and education projects supported by CPA to be outstanding. Clearly, the panel system, coupled with the discretion of the program directors, is effective at funding good research.	

[3] If "Not Appropriate" please explain why in the "Comments" section

2. Does the program portfolio promote the integration of research and education?

Yes.

Comments:

The CPA program does an excellent job integrating graduate training and research. One way to see this is that almost all of the funding in the proposals is going to support graduate students as research assistants, as opposed to equipment, travel, etc. Furthermore, many of the best jackets we viewed had outstanding integration plans with undergraduate courses, directly bringing material from research programs into the classroom. Finally, CPA supported key workshops focused precisely on this question, including one on Programming Language Education (which had a direct impact on the ACM Curriculum) and one on Compiler Research and Education (among others.)

3. Are awards appropriate in size and duration for the scope of the projects?

No.

Comments:

In general, we were alarmed at the cuts made to the budgets of many proposals:

In 2007, 15% of the CPA proposals were cut by 60% or more; almost 30% of the proposals were cut in half; and 40% of the proposals were cut from 30-40%.

Of course, we recognize that these cuts helped to significantly improve the funding rates of proposals, but for small awards in particular, we are concerned that cuts had a significant impact on the portfolio, limiting research to projects that could be done with one graduate student. We worry that, particularly in CPA where there is a need to build large software and hardware systems to do cutting-edge research (e.g., compilers for

new programming languages, simulators and chips for new architectures, etc.), such tasks cannot be undertaken with current funding support. Similarly, we worry that integrative research, which combines theory and practice, has been limited and that this is inconsistent with NSF's goals of supporting "transformative" research.

Two things help alleviate these concerns: First, the recent introduction of "medium" and "large" grants help ensure a better balance of the portfolio. We suggest that it is important to track "effort" (i.e., number of students and/or number of summer months needed to accomplish the research goals) more than "dollars" in the proposals, and to ensure that "medium" and "large" proposals do not degenerate into *n* PIs with 1-student per PI.

The second change that helps alleviate these concerns is the more careful allocation of reserves across sub-areas, and the renewed emphasis on core areas such as software. Our understanding and hope is that this will help avoid drastic budget cuts for the important areas of CPA that were underserved.

4. Does the program portfolio have an appropriate balance of:

Innovative/potentially transformative projects?

Yes.

Comments:

The committee felt that there was a very strong balance of innovative and potentially transformative projects, especially at the "small" end of the research scale. As noted in the previous response, there was some concern that the larger end was underserved due to budget cuts. We felt that if this situation persists, then there is a danger that the core areas of CPA will tend towards conservative advances instead of transformative work.

5. Does the program portfolio have an appropriate balance of:

Inter- and Multi- disciplinary projects?

Yes.

Comments:

We note that CPA touches on almost all of the cross-cutting programs (e.g., Expeditions, Science of Design, CyberTrust/Trustworthy Computing, Real World, CyberPhysical Systems, etc.) and that CPA researchers are heavily involved in these efforts. Indeed, there was some concern that the community perceives that, to do "large" projects, one must step outside the core into one of the designated crosscuts. While cross-cuts are generally commendable, care is needed to ensure a proper balance with core programs. The committee was pleased to see that CCF is placing a renewed emphasis on core areas such as software and applied algorithms.

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program?

Comments:

As noted earlier, the committee did not feel that the budget cuts resulted in an appropriate balance between project sizes. The committee had a hard time determining whether there is proper balance between multiple- and single-investigator awards from the data we had available. In general, the committee worried that PIs were left to guess whether it was better to team up or submit separate proposals – e.g., do panelists and program officers see the larger budget numbers on multi-investigator awards and cut the budgets more?

Another concern is that tracking CPA as a cluster does not tell the whole story with respect to funding rates. While the cluster had a funding rate of 22% over the 2005-2008 period, we found that the rates were significantly higher in some sub-areas than others. For instance, in 2006, the "software" portion of CPA (including compilers,

software engineering, and programming languages) had a funding rate of about 14% whereas CPA as a whole had a funding rate of 21%. Furthermore, the letters sent to PIs across all areas indicated that acceptance rates were around 10-15%. We found that in fact, this last number was misleading (the actual funding rate was sometimes higher) because of the way reserves were ultimately spent. Nevertheless, this has lead to a perception by some in the community that, when combined with budget cuts, core CPA programs are not the place to send proposals.

To ensure a better balance, we suggest that it is important to track funding rates, grant sizes, etc. at a finer granularity than the clusters and to more clearly communicate this information to the community. Again, we are happy to see that the current program officers are aware of these needs and have taken steps to avoid these issues in the future.

7. Does the program portfolio have an appropriate balance of:

Awards to new investigators?

NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.

Yes.

Comments:

In CPA we saw the following statistics: For 2006, 27% of the proposals were from new PIs and 23% of the funded proposals were from new PIs. For 2007, 29% of the proposals were from new PIs with 15% of the funded proposals going to new PIs. And for 2008, 25% of the proposals were from new PIs while 14% of the funded proposals went to new PIs. The committee felt that these ratios were relatively good, though it would be useful to have more historic data and data from other clusters, divisions, and directorates for comparison. For example, it is difficult for us to tell whether the drop in proposals from new PIs is an on-going trend.

The CAREER program is obviously healthy and doing an excellent job providing long-term support for new PIs. We feel this is a crucial program.

8. Does the program portfolio have an appropriate balance of:

Geographical distribution of Principal Investigators?

We were unable to tell for sure from the data given, but believe this to be true.

Comments:

We do believe that the program officers did an excellent job taking advantage of EPSCOR funds to ensure worthy proposals were funded in these under-served states.

9. Does the program portfolio have an appropriate balance of:

Institutional types?

We were unable to tell from the data given.

Comments:

10. Does the program portfolio have an appropriate balance:

Across disciplines and sub disciplines of the activity?

Yes, for the most part. Again, this was difficult to quantify.

Comments:

The committee felt that in general, CPA did a good job managing funding across its sub-areas, based on our impressions reading the jackets. However, as noted, the funding rates for areas differed significantly. Also, we do not know what fraction of proposals sit in the sub-areas. Moving forward, the committee felt that the new structure and foci for CCF will help address any imbalances (e.g., in software, integrating graphics, etc.). There was some concern that under the new organization, "hardware" will be lost in the sub-area of Software and Hardware Foundations, given that some fields, such as architecture and design automation, are served only by NSF and not other agencies, and that no other directorate or cluster within CISE is focused on these areas.

11. Does the program portfolio have appropriate participation of underrepresented groups?

For women, perhaps, but not other under-represented groups.

Comments:

The summary data we saw showed that about 15% (239 out of 1522) of the PIs who submitted grants to CPA solicitations during the 2006-2008 period were female, and about 4% (64 out of 1522) of the PIs were from other under-represented groups. The funding rate for females ranged between 27-33% (21-26 proposals per year) whereas for other under-represented groups, the funding rate range from 13-16% (3 per year). Given that the overall average funding rates ranged from 21-24%, we conclude that in the category of women, CPA seems to have a relatively successful funding rate, but *not* for other under-represented groups. Therefore, CPA should focus energy on improving both the number of proposals that include under-represented PIs, and techniques for ensuring that they are of sufficient quality to be successfully funded.

Of course, we recognize that this is an on-going problem. To that end, it would be useful to provide future COVs with data over a longer period to more accurately determine the trend.

One thing we did notice is that CPA is doing an excellent job providing travel grants to underrepresented groups so that students can attend meetings and conferences.

12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.

Most definitely!

Comments:

Some examples of external reports include the following:

- *Leadership Under Challenge: Information Technology R&D in a Competitive World. An Assessment of the Federal Networking and Information Technology R&D Program*. President's Council of Advisors on Science and Technology, April 2007.
  http://www.nitrd.gov/Pcast/reports/PCAST-NIT-FINAL.pdf
- *Software for Dependable Systems: Sufficient Evidence?* Computer Science and Telecommunications Board, National Research Council, National Academies Press, 2007.
  http://books.nap.edu/openbook.php?record_id=11923
- *Assessing the Impacts of Changes in the Information Technology R&D Ecosystem: Retaining Leadership in an Increasingly Global Environment*, Computer Science and Telecommunications Board, National Research Council, National Academies Press, 2009.
  http://books.nap.edu/openbook.php?record_id=12174
- *Advancing Software-Intensive Systems Producibility*, Computer Science and Telecommunications Board, National Research Council, National Academies Press, 2007.
  http://sites.nationalacademies.org/cstb/CurrentProjects/CSTB_042212
- *Grand Research Challenges in Information Systems*, Computing Research Association, September 2003
  http://www.cra.org/reports/gc.systems.pdf

13. Additional comments on the quality of the projects or the balance of the portfolio:

A.4 Management of the program under review. Please comment on:

1. Management of the program.

Excellent.

Comments:

Based on our review of the material provided, and our discussions with the program directors, the committee thinks that CPA is doing an outstanding job managing all aspects of the program, from choosing panelists, to balancing the needs of the community, to out-reach and stewardship. For example, in the few cases we saw where directors seemed to go against panel recommendations, the reasons for doing so were well documented and well reasoned. Furthermore, we found this remarkable given the clearly heavy loads on the program directors. Finally, we note that the staff are remarkably well qualified, whether they are permanent or rotators.

2. Responsiveness of the program to emerging research and education opportunities.

Excellent.

Comments:

The program (co-)sponsored a number of research and education-related workshops including one on nano-morphic systems, one on virtual immersion in the year 2020, one on programming language education, and one on compiler research and education. Furthermore, CPA seemed to react well to emerging topics such as programmability for multi-cores, low-power architecture, and I/O needs for high-performance computing.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Good.

Comments:

It was clear to the committee that CISE and CCF give a great deal of thought into strategic priorities and planning. For example, the move to a single annual solicitation was clearly aimed at ensuring proposals could be routed to the appropriate panels in a timely fashion. Nevertheless, it is clear that the program directors would like to spend more time engaging the community and thinking strategically than doing administrative tasks, such as determining conflicts of interest for potential panelists. Again, we recommend that the right investment in IT support for the staff will help them to find the time to do such strategic thinking. Furthermore, for the permanent staff, we urge the Foundation to consider increasing the travel budget so that directors can attend meetings and conferences so that they can more easily keep in contact with the communities they serve.

4. Responsiveness of program to previous COV comments and recommendations.

For the most part, quite good.

Comments:

The committee particularly appreciated the Self Assessment document, which provided a wealth of data, along with justification and strategic plans. This was perhaps the key item asked for by the previous COV. Additionally, the staff did an excellent job coordinating with the chairs and providing information that was requested. Two things that the previous COV brought up could be better addressed: (1) the last committee asked that reviewers mark their confidence, and we agree that this is important for assessing the quality of the reviews, and (2) the previous committee suggested that they be given access to the jackets and other documents earlier so that members can spend more time looking at the data.

5. Additional comments on program management:

The committee had some reservations about the new coordinated solicitation. We recognize that this approach has certain advantages; notably that it allows directors to easily re-route proposals to the correct panel, and of course, there are economies of scale. However, we felt that for many PIs, the single deadline was problematic: it came towards the end of the semester when faculty are heavily loaded; certain disciplines (e.g., graphics) may share the deadline with submission dates for major conferences making it difficult for faculty to get a proposal together; and finally, if a PI cannot make the deadline, then they must essentially wait an entire year to submit a new proposal. There was also concern that a coordinated deadline put pressure on program directors with respect to finding suitable panelists, finding suitable meeting rooms, etc. We do believe that it is important to stick to published time-tables so that PIs can plan appropriately, and consequently we suggest that CISE take steps to measure and ascertain whether a coordinated solicitation or some alternative is the best.

PART B. RESULTS OF NSF INVESTMENTS

The NSF mission is to:

- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship. The COV should look carefully at and comment on (1) noteworthy achievements based on NSF awards; (2) ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcome goals; and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio as it relates to the three outcome goals of Discovery, Learning, and Research Infrastructure. The COV is not asked to review accomplishments under Stewardship, as that goal is represented by several annual performance goals and measures that are monitored by internal working groups that report to NSF senior management.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 <u>OUTCOME GOAL for Discovery:</u> "*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering."*

The committee found a large number of research highlights that were directly supported by CPA programs. We list two below. The first concerns Ed Clarke's Turing-award work on model checking, which has been a tremendous advance for

verification of both hardware and more recently software. This work has helped shift development practices in industry to the point where tools for verification are routinely used to ensure the absence of bugs or mis-designs that can lead to failures or security exploits. The second shows CPA's ability to directly address the needs of an impaired community through the application of technology. In this case, PIs Eve Riskin and Sheila Hemami have developed new compression techniques that enable standard cell phones to capture, compress, and decompress images of humans communicating through American Sign Language.

NSF Grants 0429120 and 0541245: Automated verification technique wins top award in computing.

Edmund Clarke, Carnegie Mellon University

On February 4, 2008, the Association for Computing Machinery (ACM) announced the winners of the ACM Turing Award, considered the top award in computing – sometimes referred to as the Nobel Prize of computing. NSF-supported Principle Investigator Edmund Clarke of Carnegie-Mellon University, along with two others (Allen Emerson, Univ. of Texas at Austin and Joseph Sifakis, of Verimag in France) was cited for "his role in developing Model-Checking into a highly effective verification technology widely adopted in the hardware and software industries."

NSF Grants 051453 and 0514357: MobileASL: American Sign Language Video Compression for Cell Phones. Eve Riskin, Univ. of Washington and Sheila Hemami, Cornell Univ.

To address the challenge of providing real-time American Sign Language (ASL) video over cell phones, one needs a way to compress the video to very low bit rates using the very limited computing power of a cell phone. A team of NSF-funded researches at the University of Washington and Cornell University is working on just this problem. The project involves design, implementation, and evaluation of new video compression methods that will allow ASL video to be transmitted over cell phones. … This would bring the freedom, flexibility, and comfort of cellular technology, which millions of Americans currently enjoy, to the deaf community.

B.2 <u>OUTCOME GOAL for Learning:</u> "*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens."*

CPA also had a number of outstanding highlights that address the learning and outreach goals mentioned above. As one example, we list here work by Richard Superfine and Russell Taylor on visualization and haptic technologies which they brought into middle-school and high-school classrooms, and used to let students perform cutting edge experiments on carbon nanotubes. As another example, we describe the Secure Technology Education and Outreach program for Under-represented Groups.

NSF Grants 9512431 & 9527192: Visualization Support for nanoScale Science, nanotechnology, and Education. Richard Superfine and Russell Taylor, Univ. North Carolina at Chapel Hill

Besides opening up the study of the basic tools of nanotechnology, these visualization tools enabled class full of middle-school and high-school students to directly perform cutting-edge experiments. The NSF ROLE program brought the interactive 3D graphics plus force-feedback system to school science classes to investigate the impact of such tools on learning and the students' view of science and scientists. The student responses were indicative: "I am really interested in being a scientist now." "I have gained a lot of respect for scientists and can actually see why they find this fun." "It astonishes me to see the technology we are using today and what it can do." "Meeting with scientists helped to put down the typical image that many people have of scientists where they have crazy, wild hair and boiling green chemicals." "He [a scientist] emailed us back and I feel so smart now because I know a lot about science and I think it was great fun."

NSF Grant 0424422: Secure Technology Education and Outreach to Underrepresented Groups.

S. Shankar Sastry, University of California-Berkeley.

One education and outreach success from the summer of 2006 is the Women's Institute in Summer Enrichment (WISE) two week residential program on the campus of the University of California, Berkeley that brings together graduate

students, post-doctoral fellows, and professors from all disciplines that are interested in Ubiquitous Secure Technology and the social, economic ramifications that are associated with this technology…Building on last year's success, the Summer 2007 program is focused on sensor networks with a healthcare and policy topics selected to compliment TRUST research areas and are expected to include (but are not limited to): Sensor Networks with healthcare, Radio Frequency Identification, Electronic Medical Records, Privacy enhancing software, networks, and policy, Rights and responsibilities of data, data owners, and data users.

B.3 <u>OUTCOME GOAL for Research Infrastructure: "</u>*Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools."*

The CPA cluster also supported some infrastructure and a great deal of experimental research, particularly in the areas of high-performance computing and architecture. We provide an example highlight below focused on a testing facility for reducing chip errors.

NSF Grant 0454123: One of a Kind Test Facility Reduces Chip Errors

Vijaykrishnan Narayanan, Penn. State Univ.

Researchers at the Pennsylvania State University (PSU) have established an accelerated test facility to understand the phenomena of radiation-induced errors in particular because they anticipate that the number of soft errors will increase as chip feature sizes become smaller, voltages are reduced to save power, clock speeds increase, and systems incorporate greater number of chips. The accelerated test facility, using the Breazeale Nuclear Reactor at PSU, is one of a kind. It permits researchers to gather actual data about soft errors. For example, experiments have confirmed that there is a strong correlation between higher failure rates and lower voltages. Aging has been shown to not affect soft error rates, while higher temperatures reduce soft errors. The researchers are developing models for soft error analysis and design methods that mitigate the effects of these errors.

PART C. OTHER TOPICS

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

C.2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

It was clear to the committee that some investment in IT support to help program officers better run programs (e.g., a database for tracking potential reviewers and their conflicts) would provide benefit across the foundation. CISE should take a leadership role here due to its familiarity with cutting edge systems developed for the conferences and workshops used by the community.

C.4. Please provide comments on any other issues the COV feels are relevant.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

In many cases where we responded "insufficient data", the data needed to address the question could have been predicted and gathered fairly easily. Other questions require better tracking (e.g., reviewer confidence, balance with respect to under-represented groups.) For future COV meetings, we suggest that *each question* come accompanied with any relevant data.

We also agree with the previous COV and suggest that having a conference call for the whole committee a few weeks before the meeting, where details such as how to use eJacket could be gone over. In turn, that would force certain materials to be available to the committee for more timely digestion of the material.

SIGNATURE BLOCK:

_____

For the [Replace with Name of COV]

[Name of Chair of COV]

Chair

Comment [v1]: Please fill in. MYV

FY 2009 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)
Emerging Models and Technologies for Computation Cluster (EMT)

Comment [v2]: Please fill in. MYV

Date of COV:
Program/Cluster/Section:
Division:
Directorate:
Number of actions reviewed: **Awards:** **Declinations:** **Other:**
Total number of actions within Program/Cluster/Division during period under review: **Awards:** **Declinations:** **Other:**
Manner in which reviewed actions were selected:

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process. Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[4]

1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?

Comments:

YES

The review methods used were primarily panels, with occasional *ad hoc* reviews used to supplement the panel expertise. Panels are a good and effective way to evaluate proposals in a timely manner. Since EMT proposals can be very broad and multidisciplinary, and panels are limited in size, the use of supplemental *ad hoc* reviews is an important mechanism for augmenting the panel expertise.

One issue that arose was disconnect between the 5-point scale that reviewers use (poor, fair, good, very good, and excellent) and the 2 or 3-point scale that panels are asked to use (non-competitive, competitive, and sometimes, highly-competitive). It was noted that the panel rating is often interleaved with funding recommendations, with panels being encouraged to rate only very few proposals in the highly competitive range. It was felt that it would be most appropriate to have the panel rating also be separated from funding decisions. Program directors can ask panels to rank proposals that they feel should be funded, and to indicate proposals that should not be funded. This will allow the reviewers to provide input in their area of expertise (evaluating the research) that can be used by the program directors when making the funding decisions.

Another mechanism for reviewing multidisciplinary activities is to have the proposal considered by multiple panels from different programs, divisions or directorates. This mechanism does not seem to have been used much by the EMT programs. It seems the program directors instead addressed this by assembling multi-disciplinary panels. While both strategies solicit input from reviewers with diverse expertise, having a proposal reviewed by multiple programs would facilitate co-funding of proposals by multiple programs. The program directors should be encouraged to expand the practice of having proposals reviewed by multiple programs in different divisions of CISE and in other NSF directorates.

[4] If “Not Applicable” please explain why in the “Comments” section

It was also noted that it is very challenging to identify panels with the appropriate expertise and to avoid conflict of interests. This is particularly difficult for program directors handling multi-disciplinary proposals like those submitted to EMT. As noted in Section C, the proposal review process would be greatly improved, facilitated and streamlined by better IT support for identifying panelists and *ad hoc* reviewers (considering both expertise and conflicts of interest), assigning proposals to reviewers, and otherwise managing the review process. Essentially, NSF program directors should have similar support as is commonly provided by conference and journal management systems. Fastlane is an excellent system (much better than grants.gov), but it could be improved.

2. Are both merit review criteria addressed

In individual reviews?
In panel summaries?

In Program Officer review analyses?

Comments:

YES

Almost all reviews and all panel summaries that the COV examined had some comments addressing both the intellectual merit (IM) and broader impacts (BI) review criteria.

The quality of the comments regarding the IM criterion varied, ranging from very relevant and detailed to quite superficial. While there was some variance among panels, in most cases, each proposal did have at least one or two reviews that provided some detailed comments addressing the IM criterion.

While the BI criterion was mentioned in most reviews and all panel summaries that the COV examined, it was almost always done in a superficial manner. This may stem from the lack of clarity of what is expected for those criteria and a lack of understanding of how to review it. This should be addressed by educating investigators so that they can prepare good BI

components of their proposals and educating reviewers about how these aspects can be evaluated. Since BI are very important, NSF might consider what could be done to strengthen this aspect of the proposals and their review, and also of the resulting projects. For example, NSF might have some suggested BI components that PIs could include in their proposals (e.g., mentor undergraduate students from groups underrepresented in computing in research experiences through REU experiences or by participating in NSF sponsored programs such as the CRA-W/CDC DREU and CREU programs).

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals?

Comments:

YES

The quality of the comments regarding the intellectual merit (IM) criterion was quite varied, ranging from very relevant and detailed to quite superficial. While the broader impact (BI) criterion was addressed in all reviews, it was almost always done in a very superficial manner. Overall, however, most proposals did have multiple reviews that provided sufficient detail, at least on the IM criterion.

Even in cases where the reviews were quite detailed, there was not always good feedback on how the proposal might be strengthened and improved. This could be addressed by adding a few targeted questions to the review template. For example, requesting reviewers to separately provide strengths, weaknesses, and suggestions for improvement.

There seemed to be some variance among panels, with proposals getting three or more detailed reviews in some cases and in other cases there being only three rather cursory reviews that did not seem to provide sufficient feedback to the proposers. We did not have sufficient data to determine if this was correlated with the program (bio, nano, or quantum).

There seemed to also be some variance in the quality of the reviews and ratings depending on the reviewer's discipline -- the reviewers from non-CISE disciplines tended to rate proposals higher than the reviewers from CISE disciplines. This may be due to differences

between disciplines (average scores in other disciplines tend to be higher than CISE), but in some cases also appeared to be due to the reviewer paying greater attention to the non-computational aspects of the work. This may be natural given their background, but in proposals that will be fully funded from CISE, it is important that there be some potential CISE contributions. In situations where this is not the case, program directors should consider seeking co-funding of the proposals with appropriate partners.

4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?

Comments:

YES

The panel summaries provide reasonable explanations and feedback to the PI. In the jackets that were examined by the COV, the summaries tended to relate and summarize the major points from the reviews, and to provide a rationale for the panel rating (2 or 3-point scale).

They seemed to do a better job of this when the proposal was either very highly rated or very lowly rated. For the majority of proposals, however, that is in the middle range, more targeted suggestions as to how the proposal might be improved would be helpful to the investigators. The suggestion made in question 3 of adding some more targeted questions to the review form would help address this.

5. Does the documentation in the jacket provide the rationale for the award/decline decision?

(Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.)

Comments:

YES

For the most part, this was done very well in the jackets we examined. The program directors did an excellent job in documenting the process and decisions.

One aspect that might be better documented is when the manner in which a proposal is funded greatly differs from the request, e.g., the amount is greatly reduced, investigators are dropped from or added to the team, etc. As mentioned below (A.3.3), there is some concern

that proposal budgets were cut without regard to the scientific needs of the project.

Based on the jackets that the COV reviewed, one area where additional detail may be warranted would be to document the rationale for cases in which the program director overturned panel recommendations (e.g., taking proposals out of ranked order, funding proposals ranked as non-competitive by the panel, or not funding a proposal that was ranked highly competitive). The COV agrees that Program Directors should have authority to take such actions. However, in some instances, the COV felt that the reasons for the decision could have been more thoroughly and extensively documented. In any case where the program director overturns the panel recommendation, the program director should try to document and justify the rationale. If the program director's decision is based on technical merits (as opposed to other reasons, e.g., to being from an EPSCOR state), then the program director should consider seeking additional reviews and postponing a decision on the proposal until its merits can be documented through peer review. Although the COV did not examine examples, proposals marked as highly competitive that are not funded should receive similar careful attention.

Finally, the eJacket system should be augmented to track when program directors overturn panel decisions and when division directors overturn program directors, and so on. This will allow for better documentation and review of these instances, and will provide the community with greater confidence in the process.

6. Does the documentation to PI provide the rationale for the award/decline decision?

(Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.)

Comments:

YES
This is done quite well. It would be nice to provide more feedback when a proposal is declined to assist the PI with their next submission. However, it is recognized that it is not feasible for the program directors to provide detailed, customized feedback to each declined proposal given the current program director workload. One suggestion already mentioned in response to question A.1.3, would be to add some targeted questions to the individual review form asking the reviewers to note strengths, weaknesses, and how the proposal might be improved.

7. Is the time to decision appropriate?

Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals.

Comments:

YES

The EMT program directors did an excellent job in getting their proposals processed in a timely manner. In all three years under review (2006, 2007, and 2008), a decision was made on roughly 90% of the proposals within 6 months. Most of the remaining proposals had decisions within 6-9 months with just a few (1% in 2006, 3% in 2007, 0% in 2008) receiving decisions within 9-12 months.

Without greater automated support for the reviewing process (ranging from program directors selecting proposals, to reviewer selection and management, etc.) and/or more high quality staff, it does not seem feasible to reduce the time to decision.

8. Additional comments on the quality and effectiveness of the program's use of merit review process:

Several of the issues identified above would be assisted by providing the program directors with better, automated support for supporting the reviewing process, e.g., identifying reviews, conflicts, assigning reviewers, etc. This is addressed in more detail in section C.

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	**YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[5]**
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments:	

[5] If "Not Applicable" please explain why in the "Comments" section

YES

Due to the multidisciplinary nature of the EMT programs, the reviewers necessarily must be taken from a broad spectrum of disciplines. In the jackets that were reviewed by the COV, the panels did seem to include reviewers from a variety of disciplines that seemed to be well aligned with the types of proposals that were reviewed by the panel.

On the other hand, because the reviewers were drawn from a variety of disciplines, many were not known by the COV, and hence it was difficult to determine if they were the best qualified reviewers. This is another instance where it would be useful to have the reviewers self rate their expertise in the area of the proposed work and their confidence in their opinion about the proposal. Scheduling the panels well in advance would assist in securing the most qualified and distinguished panel members covering the anticipated breadth of expertise.

In a few cases, there seemed to be a lack of CISE expertise on the panels. This does not seem desirable for a program in the CISE directorate. However, if the program were to be a cross-cutting program of NSF, that included funding from other directorates, then one would expect panels with varying composition representative of the participating directorates.

An automated system supporting reviewer selection based on areas of expertise would greatly facilitate the process of putting together panels. See Section C for more details.

2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups?

DATA NOT AVAILABLE

From the jackets reviewed by the COV, it seemed that the geographical distribution of the reviewers was quite good.

Unfortunately, though, only geographical data was available to evaluate this aspect of the process. The demographic data of the reviewers is self-reported, and many reviewers do not do that. Also, there was not good data reporting the institution type of the reviewers. If this is important to NSF, then greater efforts should be made to explain to reviewers the purpose for requesting this information. If reviewers understand this better, then they would be more willing to provide this type of information.

3. Did the program recognize and resolve conflicts of interest when appropriate?
Comments:

YES

No conflicts of interest were noted in the jackets reviewed by the COV. Hence, it appears that the program directors and the reviewers handled conflicts well and professionally.

Additional comments on reviewer selection: Several of the issues identified above would be ssisted by providing the program directors with better, automated support for supporting the viewing process, e.g., identifying reviews, conflicts, assigning reviewers, etc. This is ldressed in more detail in section C.

A.3 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE[6], OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: APPROPRIATE Overall, the COV found the research and education projects supported by EMT to be of high quality. Generally, the EMT success rates for proposals tended to be higher than the CISE and NSF success rates. While higher than average success rates do not in themselves imply lower quality, they do warrant further explanation. For example, at first glance, the reported success rate of 45% for 2008 seems quite high compared to the 33% and 29% success rates for EMT for 2006 and 2007, respectively, which were already significantly higher than CISE and NSF success rates that varied from 20%-24% for 2006-2008. Based on data provided to the COV, one explanation for this increased success rate was that EMT received significant funds from other areas of CCF, enabling more EMT proposals to be funded. In addition, based on the jackets examined by the COV, and the statistics provided regarding award sizes (see concerns noted in question A.3.3 regarding award size), another possible explanation may be that some awards that should have been classified as SGER awards were instead awarded as regular awards. If this is the case, then the success rates reported are artificially high - SGER awards are not included in success rate calculations because they do not undergo the same peer review process as other awards. Due to the importance of statistics such as success rates, program directors should be careful to use the most appropriate funding mechanism when making awards.	

[6] If "Not Appropriate" please explain why in the "Comments" section

2. Does the program portfolio promote the integration of research and education?

Comments:

APPROPRIATE

The EMT program portfolio included a balance of educational projects (REU sites, workshops, etc.) and research proposals. The educational component of the research proposals themselves normally includes the training of graduate students, and often includes other elements such as undergraduate research, summer programs, workshops, outreach, etc. The EMT program also sponsored a series of high visibility workshops from Fall 2007 through Summer 2008 covering the three EMT areas – bio, nano and quantum, all of which lauded the accomplishments of the research supported by the EMT program and called for the program to continue.

3. Are awards appropriate in size and duration for the scope of the projects?

Comments:

NOT APPROPRIATE / INSUFFICIENT DATA

Generally, from the data provided, it appeared that funded proposals had very large budgetary cuts (in 2007 and 2008, more than 40% of the awards had their budgets cut by 50% or more) and the average annual award size for EMT awards was alarmingly low (about $109K, $110K, and $146K in 2006, 2007, and 2008, respectively).

Based on the jackets reviewed, it seemed that budget cuts were not usually made based on the needs of the project or concerns raised during the review process. Instead, it seemed that budget cuts were used to increase overall funding rates, and the amount of the cuts seemed to be inversely correlated with how well the proposals reviewed, i.e., highly rated proposals were likely to be cut less than lower rated proposals. While the COV appreciates and supports efforts to fund worthy proposals, we do not believe the community is best served by making many small awards. This simply requires PIs to write more proposals in order to collect enough funds to support their research programs. Instead, proposals should be funded at a level that enables the investigators to carry out the proposed research.

The COV believes that *a minimal award* should include, for each PI, support for one graduate student at a level appropriate for the institution plus one month of PI support and funds for other resources necessary for the project (e.g., experimental costs). While it is not possible to tell from the data provided, the COV has concerns that many EMT awards were falling below this level. In particular, given that 50%, 44% and 35% of the awards in 2006, 2007, and 2008, respectively, had 2 or more PIs, the average award per PI per year was significantly less than the average annual award.

4. Does the program portfolio have an appropriate balance of:

Innovative/potentially transformative projects?

Comments:

APPROPRIATE

Yes. The EMT program focuses on innovative and potentially transformative projects, and hence it is appropriate that most awards are of this nature.

5. Does the program portfolio have an appropriate balance of:

Inter- and Multi- disciplinary projects?

Comments:

APPROPRIATE

Yes. The EMT program focuses on multi-disciplinary projects, and hence it is appropriate and one of the strengths of the program that most awards are of this nature.

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program?

Comments:

APPROPRIATE

Overall, the EMT portfolio includes a mix of single and multiple investigator awards, and awards of various sizes.

However, as previously noted, the COV has some concerns regarding the relatively small sizes of the awards.

Also, there is a possible concern over the increase in the percentage of single investigator awards in 2008. However, it is possible that many of those awards were in fact collaborative awards that involve multiple institutions, which are not easily identified currently. The COV recommends that NSF add this information to the award tracking system so that these types of awards can be noted and tracked properly.

7. Does the program portfolio have an appropriate balance of:

Awards to new investigators?

NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.

Comments:

APPROPRIATE

Base on the data provided to the COV, it seems that roughly 1/3 of all PIs on awarded proposals were new PIs, which is quite high and shows that the EMT program has been very successful in bringing new PIs to NSF.

While CCF as a whole had a better average success rate for CAREER awards than CISE or NSF, there was no data provided to determine which awards could be considered to be from EMT areas.

The COV noted that EMT did not tend to use the SGER mechanism to fund new PIs. In particular, of the 7, 1 and 3 SGERs awarded by EMT in 2006, 2007, and 2008, respectively, only 1 in 2006 and 1 in 2007 were awarded to new PIs. The COV encourages the program directors to take more advantage of the newly established EAGER and RAPID programs that are replacing SGER for new investigators.

8. Does the program portfolio have an appropriate balance of:

Geographical distribution of Principal Investigators?

Comments:

APPROPRIATE

Based on the listing of final actions for 2006, 2007, and 2008, it appears that EMT awards include investigators from states geographically distributed around the nation. In 2008, there was a large increase in awards to investigators from EPSCOR states (8 in 2008 vs. 1 in 2006 and 2 in 2007).

9. Does the program portfolio have an appropriate balance of:

Institutional types?

Comments:

INSUFFICIENT DATA

The data available to the COV did not classify institutions. However, based on personal knowledge of the COV members, it does appear that awards were made to a variety of institution types. If NSF cares about such criteria, then it should collect data so that it can be evaluated. This could easily be added to both Fastlane and ejacket.

10. Does the program portfolio have an appropriate balance:

Across disciplines and sub disciplines of the activity?

Comments:

APPROPRIATE

EMT programs are by nature multidisciplinary. Hence, it is appropriate that most EMT awards include investigators from multiple disciplines.

11. Does the program portfolio have appropriate participation of underrepresented groups?

Comments:

APPROPRIATE

The success rates for women were similar to the success rates for EMT overall, while the success rates for other underrepresented groups were slightly less than for EMT overall. The number of proposals considered by EMT that were submitted by underrepresented groups was similar to their representation among researchers in the field. Hence, EMT is more or less consistent with the overall situation in the CISE related disciplines.

12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.

Comments:

APPROPRIATE

The EMT programs, particularly the biological and nanotechnology programs, are extremely relevant to national priorities such as healthcare and technology. Listed below are some reports and programs that emphasize these issues.

- The *Nanoelectronics Research Initiative* (http://nri.src.org) is a nationwide program launched in 2005 by the Semiconductor Industry association and NSF to discover a computing technology (the individual computing elements and the computing architecture) for digital electronics beyond CMOS in the 2020 timeframe. The mission and description (http://nri.src.org/member/about/mission_nri.asp) show that the research agenda of the EMT nano program is central to the future of computing.

- In March 2009, the NAE Committee on Engineering's Grand Challenges identified 14 areas awaiting engineering solutions in the 21st century. These are documented on the website (http://www.engineeringchallenges.org/) and in this report (chttp://www.engineeringchallenges.org/?ID=11574). Several of these challenges fall in the EMT areas, e.g., Advance Health Informatics, Engineering Better Medicines, Reverse Engineer the Brain.

- *Leadership Under Challenge: Information Technology R&D in a Competitive World. An Assessment of the Federal Networking and Information Technology R&D Program*. President's Council of Advisors on Science and Technology, April 2007. http://www.nitrd.gov/Pcast/reports/PCAST-NIT-FINAL.pdf

13. Additional comments on the quality of the projects or the balance of the portfolio:

A.4. Management of the program under review. Please comment on:

1. Management of the program.

Comments:

Generally, the management of the EMT programs was very good. The program directors did an outstanding job of managing very complex, multidisciplinary programs. They assembled review panels with reviewers with diverse expertise. They encouraged community involvement, including sponsoring an outstanding series of workshops focused on the three major EMT themes (bio, nano, quantum) from Fall 2007 through Summer 2008. Overall, we found the program directors did an outstanding job and were extremely dedicated to the community in the face of extremely high workloads.

One situation that could have been handled better was the communication to the community about the structural changes to CCF that eliminated EMT as a program, and moved its components to multiple new CCF core programs and also moved to single common annual solicitation deadlines, which fell earlier than previous EMT deadlines. Based on anecdotal evidence, such as the extremely low number of core submissions to what would previously have been EMT programs, it appears that either many investigators did not fully understand that EMT had been eliminated and would no longer be soliciting proposals as a separate entity or that they choose not to submit their EMT type proposal to the new CCF core programs. Some members of the COV had the impression that the situation was the latter, that PIs did not want to submit their proposals to the core programs because they were concerned about appropriate panel membership and expertise to review EMT type proposals. Part of this situation is perhaps understandable given the confusion that comes with any reorganization and an earlier series of deadlines. Nevertheless, NSF should strive to better inform investigators (by email to all current and past EMT PI's, for instance) when changes occur and to reassure them that appropriate measures will be taken to ensure that their proposals are still welcome and encouraged, and that qualified reviewers would be secured for them.

2. Responsiveness of the program to emerging research and education opportunities.

Comments:

EMT by its nature was designed to foster and support emerging trends and is strongly multi-disciplinary. The series of workshops on EMT foci areas (bio, nano, and quantum) sponsored from Fall 2007 through Summer 2008 provided community building and were outstanding educational and training opportunities.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

The EMT program directors reported having a great many interactions with program directors in other divisions and directorates. This type of interaction is absolutely essential for multi-disciplinary activities such as those in EMT. The COV has some question, however, as to why these interactions did not lead to significant co-funding of awards, as documented in the materials provided to the COV.

The series of workshops sponsored by EMT from Fall 2007 through Summer 2008 were an excellent vehicle to gather together experts in the field and identify important future trends. This is a very successful model that other programs in CCF and CISE are encouraged to follow. The COV encourages NSF to take more of the workshops' recommendations into consideration in their planning and prioritization processes. For example, the consensus opinion of the current and past EMT PIs was that there still needs to be EMT-specific panels for proposal review to keep these areas well represented and to continue to support their emerging fields.

Finally, we must note that program directors, particularly permanent staff, have such limited budgets that they cannot travel to the major meetings in their field, something that is absolutely imperative if they are to remain current and connected with the field.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

The previous COV recommended that CCF better prepare for the COV visit by preparing data in advance. The COV was impressed with the amount of effort that NSF invested in preparing for the COV. The self-study document was very helpful in providing an overview of CCF, and there was much more advance preparation done for the COV than for the previous COV. Nevertheless, it would have been beneficial to have more data prior to the visit since that way the visit can focus on strategic issues.

The previous COV recommended more journal and conference-like key word support for reviewing, which is also one of the current COVs major recommendations. The reviewer expertise and conflict ratings would greatly facilitate the formation and management of panels. More detail is provided in Section C.

5. Additional comments on program management:

The elimination of EMT as a separate program and the integration of the EMT components into other CCF programs is a cause of great concern to the EMT community. A very real concern with the new organization is that by separating the various aspects of a particular program, e.g., the bio program which has been moved in part to AF and another part to SHF, that NSF loses the overall program identity that was one of the major strengths of the former EMT cluster. The series of NSF-sponsored workshops held from Fall 2007 through Summer 2008 noted the benefits of retaining the bio, nano and quantum topical areas as coordinated and identifiable entities. The COV strongly endorses this view, but also recommends that that these areas best fit as cross-cutting NSF-wide areas. Such a change would further emphasize the multidisciplinary foundations of these programs, and would encourage more substantial cross-directorate interaction in the form of co-funding, which would enable more proposals to be funded in this area.

The COV also has some serious concerns with the reorganization of the CISE solicitations to have a single common annual deadline. While this may facilitate some tasks internally, such as the proposal swapping among program directors to ensure proposals are reviewed by the right program, there are some rather serious drawbacks for PIs, the most serious of which is that if a deadline is missed for any reason, then the investigator must wait another year to submit. This can be a major problem for junior faculty who rely on NSF for their funding. A possible compromise might be to have two deadlines per year rather than one. This would also permit more timely revision and resubmission of a declined proposal, rather than waiting an entire year. If it is feared that too many proposals will be submitted with more deadlines, then a limit on the number of proposals an investigator could submit on an annual basis (rather than per solicitation) could be set.

Finally, as mentioned elsewhere in this report, there are many aspects of the proposal review process that could be facilitated and expedited by improved IT support, e.g., to match proposals with reviewers with the proper expertise, etc. This should be done on an NSF wide basis. More detail is provided in Section C.

PART B. RESULTS OF NSF INVESTMENTS

The NSF mission is to:

- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship. The COV should look carefully at and comment on (1) noteworthy achievements based on NSF awards; (2) ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcome goals; and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio as it relates to the three outcome goals of Discovery, Learning, and Research Infrastructure. The COV is not asked to review accomplishments under Stewardship, as that goal is represented by several annual performance goals and measures that are monitored by internal working groups that report to NSF senior management.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 OUTCOME GOAL for Discovery: "*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.*"

Award Title: A Systems Approach to Genomic Signal Processing: From Signal Extraction to Regulatory Intervention

Comment [v3]: Please add grant number. MYV

PI: Ed Dougherty

Institution: Texas Engineering Experiment Station

This research uses mathematical methods of engineering to derive therapeutic strategies to alter genetic regulation for the purpose of driving cells away from pathological states. For instance, they have designed a network based on data from melanoma patients, derived an intervention policy to keep cells out of metastatic states, and have demonstrated the success of this policy in simulation studies. This research may lead to personalized treatment of cancer based on an individual's molecular make-up. More generally, it will help lead to a transformation of medicine into a modern systems engineering discipline.

Award Title: Probabilistic computing and biological applications (0726969)

PI: David Anderson, http://www.inside.nsf.gov/nsf_highlights/dva@ece.gatech.edu

Institution: GA Tech Research Corporation - GA Institute of Technology

Professor Anderson and his team at Georgia Institute of Technology and Rice University have designed computing elements and algorithms that not only withstand but exploit computational errors resulting from extreme device scaling. This will have a large impact in computing with nano-scale devices, silicon or otherwise, by enabling useful computing systems to exist in the face of manufacturing variations and random computing errors.

Award Title: Spin-Bus for Quantum Information Processing (0523675)

PI: Mark Friesen

Institution: Univ. of Wisconsin-Madison

The objective of this research is to characterize and develop all aspects of the spin-bus architecture for quantum computing. They have a proposed an architecture that enables

long-range spin interactions, rather than short-range spin interactions.

B.2 <u>OUTCOME GOAL for Learning:</u> "*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.*"

Award Title: Engineering Principles in Biological Systems (0709983)

PI: Mitra, Partha

Institution: Cold Spring Harbor Lab

Three workshops in a series entitled Engineering Principles in Biological Systems at Cold Spring Harbor Laboratory in 2007, 2008, and 2009 have brought together scientists with strong theoretical or mathematical backgrounds, and an active interest in applying engineering principles to the study of biological systems, for mutual education and collaboration. Participants derive from engineering and computer science, biology, and the physical sciences, and their topics of research span cellular, systems and population biology. These workshops will promote the development of an emerging approach to theoretical biology with more formal emphasis on design or engineering principles. Pedagogical goals and accomplishments include the opportunity for biological researchers to learn about engineering theories, and for engineering theorists and computer scientists to learn about biological problems they might help to be understood.

Award Title: Development of the Nanomanipulator: A Real-Time Scanning Probe Microscope Interface for Nanometer Science (9512431)

PI: Richard Superfine

Institution: University of North Carolina at Chapel Hill

Computer visualization played a large part in carbon nanotube studies. The ability to rapidly explore hypotheses with immediate visual analysis of results led to fundamental new understanding in nanoscale bending and buckling and to the demonstration of atoms acting as gear teeth, atomic-lattice interlocking controlling how electrons flow between nanoscale parts, and nanoscale torsional coupling. Besides opening up the study of the basic tools of nanotechnology, these visualization tools enabled class full of middle-school and high-school students to directly perform cutting-edge experiments. The NSF ROLE program brought the interactive 3D graphics plus force-feedback system to school science classes to investigate the impact of such tools on learning and the students' view of science and scientists.

B.3 OUTCOME GOAL for Research Infrastructure: "*Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools.*"

Award Title: EMT: Toward Universal Bottom-Up Nanofabrication with DNA

PI: Winfree, Erik

Institution: Caltech

One of the greatest contrasts between biological organisms and human technology lies in how they are constructed. Plants and animals grow from the inside out, often from a single cell to an organism containing billions of cells, each of which is built from molecular components that are manufactured with atomic precision within the cell. In contrast, mankind's greatest engineering marvels, such as airplanes and skyscrapers and computers, are put together from the outside in, with components being manufactured in factories and assembled piece by piece. In the biological "bottom-up" approach, the assembly process is guided by the components themselves, while in the engineering "top-down" approach, there is an entity conceptually above the object being built that supervises and guides the manufacturing process. Human engineering has mastered top-down methods to create systems of great complexity (but has not extended them to the atomic and molecular scale) and has exploited bottom-up methods for the synthesis of diverse molecular, polymeric and crystalline structures (but has not created information-rich structures of great complexity). This collaborative project demonstrates how bottom-up techniques can create complex atomically-defined structures, as biology does, by embedding information and computational processes within the molecules themselves.

Award Title: Programmable Microfluidics: A Universal Substrate for Biological Computing

PI: Jeremy Gunawardena,
http://www.inside.nsf.gov/nsf_highlights/jeremy@hms.harvard.edu

Institution: Harvard University

An NSF-funded inter-disciplinary team of researchers has developed the first tool that automates the design flow for complex microfluidic chips. This breakthrough is important for enabling biology researchers to quickly harness the full power of microfluidic device technologies, where the number of features that can be fit onto a single chip has been growing exponentially over the past decade. Today's microfluidic chips--also known as biological lab-on-a-chip systems--can support tens of thousands of individually-addressable storage cells as well as complex arrays of mixers, sensors, and actuators. Under the

Comment [v4]: Please add grant number. MYV

Comment [v5]: Please add grant number. MYV

existing design flow, biologists and mechanical engineers need to arrange all of these components by hand, being careful to respect the subtle and ever-changing design rules for microfluidic chips. Microfluidic design automation alleviates this bottleneck and enables researchers to concentrate on the science rather than the details of the device layout.

PART C. OTHER TOPICS

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

C.2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

While Fastlane is an excellent system for the proposal submission process, the proposal review and post-award processes could be greatly facilitated by better automated systems and IT support. Support similar to that commonly available in journal and conference management systems (e.g., www.easychair.com or the PaperPlaza system used by many IEEE journals and conferences) would allow program directors to identify reviewers with appropriate expertise and to identify conflicts of interest, and would allow for better integration of *ad hoc* reviews. The award process, including issues such as tracking when program or division directors overturn previous decisions, should be recorded and be searchable. Information regarding co-funding of awards and collaborators should be recorded in a standardized fashion so that it would be easy for NSF program officers to obtain different reports about their programs. The program officers could also benefit from a more meaningful annual and final reporting process. The collection of highlights would be facilitated by incorporating it into the annual reporting process. This would provide a more comprehensive searchable database of NSF results.

NSF program directors need to attend the major meetings in their area to maintain a connection with the community and to stay current with the latest research trends. Also, with the trend toward supporting larger awards, such as Expeditions, program directors will need to make site

visits to monitor the progress of large grants. Finally, many of the outreach activities encouraged by NSF require travel on the part of program directors. The travel budgets available to permanent NSF staff are insufficient for these purposes. The situation is so bad that some program directors have had to resort to personally paying for travel to technical meetings. NSF needs to find some way to improve this situation for its most valuable assets.

C.4. Please provide comments on any other issues the COV feels are relevant.

This report is a review of the EMT program that was eliminated in the reorganization of CCF during Summer 2008. While none of the EMT subcomponents have been eliminated, the EMT community is concerned because the different programs in each area (bio, nano, and quantum) have been placed in different CCF clusters after the reorganization, e.g., computational biology is in AF while biocomputing is in SHF. While the COV believes there are many positive aspects to the reorganization, it also appreciates these concerns of the EMT community.

Given the inherently multi-disciplinary nature of the EMT areas, the COV recommends that they should become NSF-wide cross-cutting areas. This is the proper intellectual placement of these programs, and would also address some of the issues that arose in the review. For example, co-funding of awards by different NSF directorates would be expected, and it would be natural for the portfolio to include a spectrum of projects ranging from projects that are almost entirely computational to those that have very little computational innovation, but which capitalize on previous computational research advances.

Note that the existing CDI program does not fulfill the same role as cross-cutting bio, nano or quantum programs would. The CDI program primarily focuses on the application of computational tools to enable ground breaking work in other areas, while the bio, nano and quantum programs EMT areas focus on developing emerging models and technologies in computation.

Finally, we note that many of the comments and recommendations that are made in this document regarding EMT, apply to the EMT components that now exist in other programs.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

The COV would be much more effective if the committee could have access to the data before the visit at NSF. The self-study guide was very helpful, but there were many questions that the COV was required to answer that were not covered in the self-study document. Ideally, the data necessary to answer each question could be presented in a clearly marked appendix of the self-study guides, e.g., appendix A.2.3 would provide the data NSF believes is needed to answer question A.2.3. This would enable the COV to focus on higher level, strategic issues when at NSF and meeting with the NSF staff.

NSF needs to consider how the growing number of cross-cutting programs will be reviewed. In many cases, they interact with and impact other programs which are already very multidisciplinary, such a EMT, and hence the review of either program really should include information regarding the other related programs. The submission and award statistics for these cross-cutting programs should be reported in such a manner so that those awards that overlap in topic with other programs can be pulled out and considered when the related program is reviewed. Budgetary information for the related programs should be provided so that co-funding is easily tracked.

The COV did not see many annual reports and did not see any project final reports. This was due to the limited 3 year period covered by the review. NSF should consider making information available to the COV on the awards that were active during the review period in addition to the awards that were made during the review period. This is important information to gauge the actual impact of the awards.

SIGNATURE BLOCK:

_____

For the [Replace with Name of COV]

[Name of Chair of COV]

Chair

Comment [v6]: Fill in details. MYV

FY 2009 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)
Theoretical Foundations Cluster (TF)

Comment [v7]: Fill in details. MYV

Date of COV:
Program/Cluster/Section:
Division:
Directorate:
Number of actions reviewed: **Awards:** **Declinations:** **Other:**
Total number of actions within Program/Cluster/Division during period under review: **Awards:** **Declinations:** **Other:**
Manner in which reviewed actions were selected:

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process. Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[7]

1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?

Comments:

Generally, yes. The PDs use a variety of review methods, adapting the method to the task at hand. They perform a difficult task extremely well.

While the committee was able to evaluate panel reviews, which is the main review method, the committee had a harder time evaluating the "corner cases," which are the cases where the panel did not have enough expertise and the PD chose to use ad-hoc reviews, the PD did not concur with the panel, or the DD did not concur with the PD. The problem is largely one of how NSF internal computer information systems are configured, making it difficult to identify and track such corner cases. For example, when PDs need to go outside panels and solicit ad-hoc reviews, there is no mechanism to do this within Fastlane, and PDs must gather and collect this information by personally emailing separately.

Generally: software support for review process is well below standard in comparison to journal/conference management systems. A good review management systems require reviewers to fill in a detailed review template, enables an online discussion, enables the solicitation of additional reviews, enables management of conflicts of interest, and so on.

There are also no good written guidelines for reviewers, both for individual reviews and for panels' work process. The quality of the review process depends too much on oral guidance by the PDs, leading to high variance in review standards. In particular, the rating system is not clear and has many different interpretations. Sometimes, the PDs aren't getting as much help from their reviewers as they should; many reviewers do not provide much information in their reviews, leaving the PD to "average" over sparse information. Some energy should be put into addressing this issue. It might consist of publishing some guidelines for the reviewers, which spell out in more details the expectations about what constitutes a good review. It might also include a cultural change, getting the PDs to become more active in the review process by encouraging the reviewers provide enough useful information to make a good decision.

[7] If "Not Applicable" please explain why in "Comments" section

2. Are both merit review criteria addressed

In individual reviews?

The quality of individual reviews varies tremendously. Using a template for reviews would result in increased consistency in individual reviews.

In panel summaries?

Panel summaries are usually very good, addressing both merit criteria.

In Program Officer review analyses? Yes, usually excellent but great variance between PDs.

It is clear from the reviews that there is no wide understanding on how to interpret the merit criteria. This is particularly true of the broader-impact criterion.

Comments: The PDs seems to leverage their experience and wisdom, but without guiding principles that are shared across CCF.

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals? Often, Yes.

Comments: Many provide excellent comments, but some do not. FastLane does not force the reviewers to enter comments. We saw one review with no comment whatsoever. A better reviewing template would help here. If the enhanced template were phrased as several questions to be answered by the reviewer (much like many journal/conference review forms), then compliance could be much higher.

4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Yes.

Comments: Panel summaries do a good job of summarizing the discussion and the consensus. At the same time, the rating system used by the panel is not used consistently, i.e., in many cases, it was clear that the number of proposals rated "Highly Competitive" versus "Not Competitive" was pre-tailored to advance knowledge of the budget of the particular program and the number of awards that were going to be able to be made. This would result, for example, in only two proposals being rated "Highly Competitive" when it was understood only two proposals would be funded, regardless of the quality of proposal ranked third. The committee had a strong sense, looking at individual jackets, that there were many more strong proposals that deserved funding than there was money to fund them. However, if the ratings are tailored to the funding level, there is no way to gather meaningful statistics. Thus, the committee recommends that panelists use the rankings "Highly Competitive", "Competitive" and "Not Competitive" to signal merit, independent of funding. To give more guidance to PDs on which "Highly Competitive" proposals to fund if there is not enough money, some sort of comparison or ranking in addition would be appropriate.

5. Does the documentation in the jacket provide the rationale for the award/decline decision?

(Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.) Yes.

Comments: The jackets universally contain very good documentation of the award decision.

6. Does the documentation to PI provide the rationale for the award/decline decision?

(Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.) Generally, Yes.

Comments: In some special cases, the context statement does not capture the decision process accurately, e.g., panel review vs. ad-hoc review. The committee believes that PIs should be told whether their proposals were panel reviewed or ad-hoc reviewed. (We saw some cases where the proposal was ad-hoc reviewed, but the context statement described the panel review process.)

Since ad-hoc –reviewed proposals lack panel summary statements, PDs should provide PIs with rationales for final decisions.

7. Is the time to decision appropriate?

Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals.

Yes, but the data make it somewhat difficult to answer this question. (The data should be provided as histogram for both accepted and declined proposals.)

More generally, this one of a number of questions for which COV cannot provide an answer because (1) the data is not available, or (2) it would take too much time to extract the data and reduce to the statistics we need. COV should not be asked questions about statistical information that has not been provided.

Comments:

8. Additional comments on the quality and effectiveness of the program's use of merit review process:

The PDs are doing great work under difficult conditions. Some suggestions for improving the process:

1. Reviewers should be explicitly asked to make suggestions for improvements of proposals.

2. Guidelines for reviewers would be useful.

3. A better review form should be considered. Should include confidence/competency self-reporting.

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[8]
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: Generally yes, but finding sufficient number of experienced reviewers has at times been a challenge, particularly in the case of initiatives receiving very large number of submissions. Comments: Confidence/competency self-reporting would help future COVs answer this question better.	
2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups? Note: Demographic data is self reported, with only about 25% of reviewers reporting this information. Comments: Yes geographically. COV cannot make meaningful judgment on other categories.	

[8] If "Not Applicable" please explain why in "Comments" section

3. Did the program recognize and resolve conflicts of interest when appropriate? Comments: YES, generally. CCF does a good job of explaining the rules. We found a few instances of reviews were included in spite of disclosed CoI. Better software support would be useful to manage CoI.
Additional comments on reviewer selection: The committee believes that the short time-fuse for panelist invitations is a major problem in the constructions of high-quality panels.

A.3 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	**APPROPRIATE, NOT APPROPRIATE[9], OR DATA NOT AVAILABLE**
3. Overall quality of the research and/or education projects supported by the program. The portfolio managed by the TF cluster is of outstanding quality. In fact, of the four recent Expedition funded by CISE, one, "Expedition to Understand, Cope with, and Benefit From Intractability", is a mainstream TF project, and another, "Computational Sustainability: Computational Methods for a Sustainable Environment, Economy, and Society", is in part a TF project.	

[9] If "Not Appropriate" please explain why in the "Comments" section

Some impressive highlights:

1. Channel Coding Breakthrough – M. Sudan, V. Guruswami, R. Koetter and A. Vardi
2. The development of MIMO, WiMAX, etc. – A. Paulraj
3. Enabling the next generation of environmental monitoring and more – CENS (UCLA)

Comments:

4. Does the program portfolio promote the integration of research and education?

The research mission of CCF is intimately tied to graduate education. Essentially all CCF-funded proposals support graduate students.

The COV did not receive enough data to answer this question with respect to undergraduate education. We saw several REU supplements and some RUI proposals, but not overall data. CISE needs to define better what it expects in "integration of research and education" and provide data correspondingly. For example, Several undergraduates involved in research go on to graduate school, so looking at this data is important from the perspective of CCF's research mission for graduate education as well.

Comments:

CISE should encourage PIs to use Open Educational Resources to increase the leverage of educational resources developed in CISE-funded projects.

3. Are awards appropriate in size and duration for the scope of the projects?

Most proposals' budgets have been cut significantly, in an attempt to improve award rates. It

is very difficult for the committee to assess impact of the cuts. It is clear that budgets are cut significantly, but not clear by what principles. The sentiment expressed by the committee is that NSF is asking for transformational research, while providing incremental funding.

Comments:

It'd be useful to see data on funding per PI, in terms of supported months and graduate students. Budget should be analyzed in terms of effort, rather than dollars.

There seems to be an inconsistency between success rates reported in context statements and success rates reported to COV.

4. Does the program portfolio have an appropriate balance of:

Innovative/potentially transformative projects?

The portfolio overall is highly innovative. There is no question that the research of the TF portfolio is highly transformative. We live our lives now encircled by gadgets that could not have been built without the research supported by TF.

Comments:

Almost by definition, CCF research is highly transformative. Modern lives have been hugely affected by this research.

5. Does the program portfolio have an appropriate balance of:

Inter- and Multi- disciplinary projects?

The portfolio includes a large number of inter- and multi-disciplinary project. For example, Gomes' Expedition project on computational sustainability, Milenkovic's project on Design and Analysis of Compressed Sensing DNA Microarrays, and Kempe's project on Algorithms

for Controlling Epidemic Phenomena in Networks.

Comments:

If CISE wishes to encourage inter- and multi-disciplinary research, then this should be explicitly reflected in reviewer guidelines.

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program?

Most projects are single-investigator projects, but there are a fair number of multiple-investigator projects. We found the distribution by number of PIs to be reasonable. The committee could not judge distribution of award size for lack of data.

Comments: Rules for collaborations not clear. Inter-institutional collaboration seems to be encouraged, but intra-institutional collaboration seems discouraged, with budgets for intra-institutional collaborative proposals cut significantly. CISE needs to be clear, and issue clear guidelines, on the desirability of intra-institutional collaborations.

7. Does the program portfolio have an appropriate balance of:

Awards to new investigators?

NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.

Funding rates for new PIs has increased since 2006. Success rates for new PIs have become reasonable. The committee appreciates PDs' efforts to fund extra CAREERs in a tough funding environment.

Comments:

8. Does the program portfolio have an appropriate balance of:

Geographical distribution of Principal Investigators?

Yes, EPSCOR representation increased over the review period.

Comments:

9. Does the program portfolio have an appropriate balance of:

Institutional types?

Insufficient data. The sample showed funding primarily from research I institutions.

Comments:

CCF should track and monitor its RUI grants to ensure the well being of this program.

10. Does the program portfolio have an appropriate balance:

Across disciplines and sub disciplines of the activity?

Usually, yes. We did not see a lot of numeric computing, optimization or scientific computing proposals. We also did not see a lot of proposals on physical-layer communications and image processing.

Comments: Better data is required on distribution of proposals by topic. How should CCF analyze its portfolio? How do we explain drop in submissions of proposal in certain areas?

11. Does the program portfolio have appropriate participation of underrepresented groups?

Comments:

Number of submitted proposal by female PIs seems proportional to their numbers. Their success rates are above average. Data for other underrepresented groups is too thin to draw conclusions.

12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.

YES.

Assessing the Impacts of Changes in the Information Technology R&D Ecosystem: Retaining Leadership in an Increasingly Global Environment
http://www.nap.edu/catalog.php?record_id=12174

Computational Technology for Effective Health Care:
Immediate Steps and Strategic Directions
http://www.nap.edu/catalog.php?record_id=12572

PCAST/NITRD August 2007 report:
http://www.nitrd.gov/Pcast/reports/PCAST-NIT-FINAL.pdf

Comments:

13. Additional comments on the quality of the projects or the balance of the portfolio:

The impression of the committee is that there are valuable projects that do not get funding. To substantiate this impression, one needs to decouple quality rating from funding decision.

A.4 Management of the program under review. Please comment on:

1. Management of the program. The program is very well run. CISE staff is extremely dedicated and hard working and do an admirable job under significant workload. Comments: CISE should develop ways to share best practices (wikis, visit non-related panels, etc.) CCF should leverage best practices developed for conference-paper selection. Data on discrepancies between panels, PDs, and DDs is not easily available.
2. Responsiveness of the program to emerging research and education opportunities. Generally, YES. Recent organization aligns clusters with existing and emerging research areas Comments: In the past, theoretical proposals that did not fit the TC mold (roughly corresponding to STOC/FOCS/SODA) did not do well in TC panels. The new organization of CCF should be an improvement and be more welcoming to broader theory. Moving proposals between clusters is a positive development.
3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Reorganization is positive from TF's perspective. Programs such as signal processing and communications should be clearly identified on their own and fundamental merits, and care should be taken not to refer to them as computer science.

Comments:

4. Responsiveness of program to previous COV comments and recommendations.

Yes, except for requiring reviewers to self-rate their confidence/competence. This COV aggress with the previous COV on the importance of this issue. The community is too large for us to all know everyone. Self-declaration is not a complete answer but it is a lot better than nothing, and has proven very useful in conference paper reviewing.

Comments:

5. Additional comments on program management:

CISE's Advisory Board is traditionally weak in representation in communication research and signal processing. The board membership needs to be periodically and carefully examined in general to make sure that all CISE voices are represented.

TF Committee noted that CISE seems to have an implicit rule, according to which renewal grants are very rarely funded. The Committee believes that rules should be explicit.

TF committee has great concern about concentration of solicitation deadlines.

TF Committee raised the question whether proposals should be open to the public after project's closure (modulo appropriate redaction).

PART B. RESULTS OF NSF INVESTMENTS

The NSF mission is to:

- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship. The COV should look carefully at and comment on (1) noteworthy achievements based on NSF awards; (2) ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcome goals; and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio as it relates to the three outcome goals of Discovery, Learning, and Research Infrastructure. The COV is not asked to review accomplishments under Stewardship, as that goal is represented by several annual performance goals and measures that are monitored by internal working groups that report to NSF senior management.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 <u>OUTCOME GOAL for Discovery: "</u>*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering."*

TRACKING NETWORK CONNECTIONS (MITZENMACHER)

A collaboration between Michael Mitzenmacher, a Harvard computer science professor, and researchers at Cisco, Inc., including Flavio Bonomi, Rina Panigrahy,

Comment [v8]: Please ad grant number. MYV

Sushil Singh, and George Varghese, has led to the development of new data structures for approximately tracking the state of tens or hundreds of thousands of network connections simultaneously. Many networking applications, including specialized congestion control schemes and traffic classifiers, require fast state lookups under severe space limitations. Using hash-based schemes, the research team developed data structures that are effectively implementable in hardware and that can achieve over 99 percent accuracy using significantly reduced space over traditional schemes. Such structures promise to dramatically improve performance in future generations of router technology.

*Solving Large Matrix Problems without Worries about Locality (D. Wise and M. Adams)
*

Developing a new, block-recursive style of programming for large numeric problems, David S. Wise and Michael D. Adams have achieved superlative performance without conscious concern for memory use. Because modern computers have many different layers of memory (various caches, RAM, and swapping disc), high performance has required deft, machine-specific movement of data among these memories. Their NSF-supported paradigm develops algorithms and programming tools that decompose matrices into quadrants, and each of those recursively into quadrants, so that contiguous blocks fit naturally into any level of memory in the hierarchy.

In the process they have shown that tuning for the fastest cache may not yield the best overall performance. The plots show the times for their code on Cholesky factorization, a typical problem. Although their algorithm generates more L1 cache misses (2), their times beat the manufacturers' libraries' (1). But it generates fewer L2 misses (4), and far, far fewer expensive TLB misses (3). Ironically, the algorithms are designed and implemented without direct concern for these behaviors; these results follow from the superlative locality of the block-recursive style.

The idea of cache-oblivious algorithms is not new, but these results represent the first from problems whose time is necessarily a polynomial of their necessary space. This family of problems is much larger, more practical, and consumes more expensive supercomputing resources than classic examples of cache-oblivious algorithms.

Comments:

Comment [v9]: Please add grant number. MYV

B.2 OUTCOME GOAL for Learning: *"Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens."*

#0813748: Women In Theory Workshop

Comment [v10]: Please add PI. MYV

The purpose of the workshop is twofold: first to deliver an invigorating educational program and second is to provide an outstanding opportunity to bring together women students from different departments, across the country (and possibly internationally), so as to foster a sense of kinship and camaraderie. And to provide access to the role models in this area by having senior and junior faculty present.
Further enhancing this initial relationship with a long time mentoring program which will be organized by Anne Condon. Our long term goal is that these efforts will help widen the pipeline of women doing theory.
While there are groups for "Women in Computer Science" and "Women in Engineering" at both the university and national level, our objective in creating a "Women in Theory" workshop is to enable meaningful technical interactions among the participants. There will be significant overlap
in research interests in this group to facilitate a technical program that is interesting to everyone.

#0813845: A Proposal to Support Young Scientists and Graduate Students for CTW 2008

Comment [v11]: Please add PI. MYV

In 2008, the IEEE Communications Theory Workshop took place on May 11-14 in St. Croix, US Virgin Islands. The continued success of this workshop lies in its informal and highly interactive atmosphere, in contrast to more formal conferences. As before, the workshop was single track, with five technical sessions, three plenary speakers, two panel discussions, and a hot-topics submitted poster session. The technical sessions consisted of invited lectures given by leaders in academia and industry. In addition, there were hot-topics poster session with an open call for participation. This workshop uniquely combines communications, information theory, and networking. The NSF support for travel to the workshop was carefully disseminated to women, minorities, or young researchers by the young, successful, up-and-coming organizing committee.

Comments:

B.3 OUTCOME GOAL for Research Infrastructure: "*Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools.*"

#0220590: MII: Frameworks for the Development of Efficient and Scalable Knowledge-based Systems

Comment [v12]: Please add PI. MYV

This project, expanding activities geared to attract and retain Native American students, was aimed at developing a solid collaborative research backbone, enhancing its educational program, and improving participation of a diverse student population in computer-related disciplines. The backbone, enabling a cooperative research effort in the Computer Science Department, fostered research and educational collaborations with other departments (specifically Biology and Psychology) and with other research institutions. The research backbone was articulated in four inter-dependent threads:

Data structures and methodologies for efficient parallel execution of logic and constraint programming languages

Languages and methodologies for the design of knowledge based systems

Application of knowledge-based technology in Semantic Web, Universal Accessibility, and Computational Biology

Automated debugging and component-based programming for knowledge-based applications

Enhancement of the educational program is expected to lead to improved recruitment and retention, increased transition towards graduate programs, and a stronger integration between research and education at the graduate and undergraduate level. These goals will be accomplished through the introduction of a pathways system throughout the undergraduate curriculum, where different pathways will accommodate the diverse student backgrounds. Focusing on an educational model for the training of Native American students in Computer Science, the institution expects to improve participation of a diverse student population in computer-related disciplines, with particular focus on the creation of an educational model for the training of Native American students in Computer Science. The proposed infrastructure provides research support, in the form of computing equipment (e.g., a 64-processor Beowulf platform, HP shared memory platform, robotic equipment) and human resources support (for faculty, students, and visiting scientists). The educational infrastructure includes the creation of a new computing classroom and provides human resources for the development of the new educational programs. A research team, consisting of 14 investigators, will benefit from this infrastructure by strengthening their interdisciplinary research through cross-fertilization of new ideas.

Comments:

PART C. OTHER TOPICS

See general report.

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

C.2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

C.4. Please provide comments on any other issues the COV feels are relevant.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

SIGNATURE BLOCK:

_____

For the [Replace with Name of COV]

[Name of Chair of COV]

Chair

Comment [v13]: Please fill in.

Appendix I: CCF Self-Study Report

Computing and Communication Foundations Division

Self-Study Report for Committee of Visitors (March 2009)

A. Introduction

The National Science Foundation (NSF) is an independent federal ***agency*** created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…" With an annual budget of about $6 billion, we are the funding source for approximately 20 percent of all federally supported basic research conducted by America's colleges and universities. In some fields such as mathematics, computer science and the social sciences, NSF is the major source of federal finding; in FY'07, NSF provided 86% of the federal government's basic research investments in computer science in academe.

A.1 CISE Directorate

The ***Directorate*** for Computer and Information Science and Engineering (CISE) is one of seven Directorates at NSF. CISE has three goals:

- To enable the U.S. to uphold a position of world leadership in computing, communications, and information science and engineering
- To promote understanding of the principles and uses of advanced computing, communications and information systems in service to society
- To contribute to universal, transparent and affordable participation in an information-based society.

To achieve these, CISE supports investigator-initiated research in all areas of computer and information science and engineering, helps develop and maintain cutting-edge national computing and information infrastructure for research and education generally, and contributes to the education and training of the next generation of computer scientists and engineers.

A.2 CISE Divisions

CISE is organized into three ***Divisions***: the Division of Computing and Communication Foundations (CCF); the Division of Computer and Network Systems (CNS); and the Division of Information and Intelligent Systems (IIS).

- The CCF Division supports projects that promote advances in computing and communication theory, algorithms for computer and computational sciences, architecture and design of computing hardware and software, and revolutionary computing paradigms such as quantum computing.
- The CNS Division supports projects that seek to develop a better understanding of the fundamental properties of computer and network systems through analysis, experimentation and prototyping, and to create better abstractions and tools for designing, building, analyzing and assessing future systems. CNS also provides leadership in CISE's Trustworthy Computing program, and leads CISE-wide investments in research infrastructure and computing education.
- The IIS Division supports projects that seek to increase the capabilities of human beings and machines to create, discover and reason with knowledge, to advance our knowledge of how computer systems perform tasks autonomously, robustly and flexibly, and to optimally integrate social and technical systems and capabilities.

The CISE budget is appropriated in four directorate accounts: CCF account; CNS account; IIS account; and, the Information Technology Research (ITR) account. Funds appropriated in the ITR account are used to support emerging scientific priorities in computing, and to ensure that the projects CISE supports include a rich mix of single-investigator, multi-investigator, and center-scale awards. For example, the Expeditions program, which is described later in this document, is funded from the ITR account.

The operating budgets for the directorate over the review period (FY'06 – FY'08) are described in Table 1 below.

	FY'06	FY'07	FY'08	% change over FY'06
CCF	105.3	122.76	143.63	36.4
CNS	141.07	162.77	174.16	23.5
IIS	103.78	119.26	139.33	34.3
ITR	146.2	121.89	78.14	-46.6
Total	496.35	526.68	535.26	7.8

Table 1: CISE Funding

(dollars in millions)

Funding in CISE increased by 7.8% during the review period, while funding in the CCF division account rose by 36.4%, the largest percentage increase of all CISE accounts. Funding in the ITR account declined over the period, with these funds allocated to new scientific priorities in the CISE divisions.

A.3 CISE Programs

Each division supports a handful of ***core programs*** that support projects within a field or small number of fields of computing research and education. Each core program is supported by a team of Program Directors who manage annual proposal competitions, oversee awards made, and serve as ambassadors to the research and education communities it supports.

In addition to the core programs, each division also supports special emphasis programs that may, for example, help crystallize an emerging research trend, or capitalize on, often multidisciplinary, research and education interests the division has in common with other NSF divisions, directorates, federal agencies, or industry groups. The special emphasis programs – which typically, though not always, have lifetimes of 1-5 years – are also supported by teams of Program Directors.

The prioritization process within each program is handled by discussion among Program Directors. Program Director teams function effectively in this regard and decisions are almost always made without conflicts arising.

CISE-funded awards support a range of project modalities, including single investigator awards, multi-investigator awards, and centers. PIs may be researchers beginning their careers as junior faculty or senior investigators widely recognized as leaders in their fields.

CISE (and, *ergo* CCF) is committed to increase average award size. Despite the limited budget growth in the directorate during the review period, the average annual CCF award has risen from $96,600 in 2006 to $107,500 in 2008.

To monitor progress in awards made, Program Directors review the annual/final reports. For larger awards a variety of additional management and oversight strategies are used, depending on the project scope, award size and risk. These strategies include annual site-reviews and external review committees.

CISE invites PIs to submit annual ***highlights*** (formerly called nuggets) that describe research outcomes generated with CISE support. These highlights are extremely important in informing our national stakeholders of the results of NSF funding. It is important that the CCF community contributes highlights when feasible, so that they can be incorporated in CISE's and NSF's

narrative. Other measures of successful outcomes of CCF-funded research include industry transitions, prestigious awards, patents, etc.

Some recent CCF Highlights were among the small number of Highlights selected from all of NSF for inclusion in the NSF Congressional Budget Request. The PIs behind these research projects are Lastra (University of North Carolina, CCF - 0702712, Power Aware Graphics Hardware) for the FY'08 Budget Request and Levoy (Stanford University, CCF - 0540872 Active Computational Imaging Using a Dense Array of Projectors and Cameras) for the FY'09 Budget Request. Other highlights of note include the Guruswami-Vardy result, achieving the fundamental limit of error correction (CCF 0343672 and CCF 0514890) and the Koutis-Miller-Tolliver work using spectral graph theory for image segmentation (CCR 0635257). A notable industry transition from a CCF PI is the adoption of WIMAX created by CCF awardee, Arogyaswami Paulraj among others. There are countless many more success stories.

B. Response to 2006 CCF CoV Report

The last CCF CoV met at NSF on June 15th and 16th, 2006. The COV produced a report that highlighted several concerns. These concerns are identified and addressed below.

- While the CoV was happy with the overall quality and timeliness of the review process they expressed concern that some reviews were not informative. They were also concerned that in the Theory of Computing area panels were so broad that there wasn't sufficient expertise on focused areas. They felt that having each user assign a "confidence" level to their review, as is done in conference program committees would help. They were also concerned about the uneven attention paid to the Broader Impact criterion.

  Having Program Directors who are experts in the area of the program they direct is key to addressing many of these concerns. This is the case with the current set of Program Directors. In particular, the PDs who ran the Theory of Computing program element during the review period are respected members of this community. The panels chosen by knowledgeable Program Directors tend to be more appropriate for the proposals under review, and we believe that this has been the case over the last three years. PDs routinely ask panels to write informative reviews and to address the Broader Impact criterion. When a proposal does not fit well in any panel, Program Directors seek *ad hoc* reviews from experts to get useful reviews. In addition, our PDs take great care in writing informative review analyses, especially for declined proposals.

- The CoV was impressed with the management of CCF and happy with the reorganization into programs. They suggested a revision in the program structure to get rid of anomalies. The CoV was also concerned with PDs being overwhelmed with a large number of proposals. They wanted greater transparency (to the CoV) on the budget allocation process in CCF.

  In the summer of 2008 we reorganized the programs to be more intellectually coherent. This new organization took effect in FY '09. With the hiring of new PDs, and the slight reduction in number of proposals submitted to the core over the last two years, the workload for PDs has become more manageable, although periods of intense workload are unavoidable. The creation of programs was intended to allow PDs in CCF discretion in allocating funds and responding nimbly to changing demands from different areas. Much of the funding of awards is done directly from a reserve account for the entire program and not from the accounts for individual program elements. Thus, there is a trade-off between fine-grained transparency and allowing programs to be responsive to changing needs. We feel that reporting budgets at the program level is a good compromise.

- The CoV considered the overall quality of funded projects excellent. However they were concerned about low funding rates and small amounts of funding (again, especially in the Theory of Computing). They were also concerned that high-risk projects and multidisciplinary projects would not do well in the panel system.

  The current review period also saw low funding rates, especially in CPA (Table 7) and reduced budgets in some programs in TF (Table 4). These were unavoidable because of the reduction in funding of university research from DoD agencies and the overall CISE budget. Nevertheless strong advocacy from the theory community led to an increased budget for TF in 2007 that has been sustained. Our own emphasis on software led to increased funding for CPA in 2008 (Table 6), although this was largely absorbed to pay down commitments made in prior years. We will sustain the higher funding rate for CPA and this should lead to increased success rate in future years since obligations from prior years are now lower. In addition, we have created interdisciplinary and crosscutting programs that enable TF and CPA researchers to find other sources of funding. For CPA researchers in particular, opportunities were available in the FODAVA, HECURA, Software for Real-world Systems, and Science of Design programs. (See Table 13 at the end of Section E.) The budgets for these programs are not included in the CPA budget; hence the overall funding to the CPA community has gone up even further than shown by the change in the CPA budget. For researchers in TF, there were also interdisciplinary programs like MCS and SING (Table 13) that provided additional funding. EMT has had a very good funding rate during the review period.

  Program Directors routinely talk about the importance that NSF places on high-risk, potentially transformative research when they charge their panels. The Expeditions program has been created explicitly with the goal of supporting such research. At NSF multidisciplinary research is also a priority. *Ad hoc* reviews and reviews in more than one panel are some of the mechanisms available to ensure fair reviewing of such proposals. In addition, Program Directors have discretion in overriding more "conservative" panel views if they feel that a proposal is meritorious. The success of the first year of the CDI program in FY '08 involving a large (close to 90) team of Program Directors across NSF points to NSF's ability to run multidisciplinary programs.

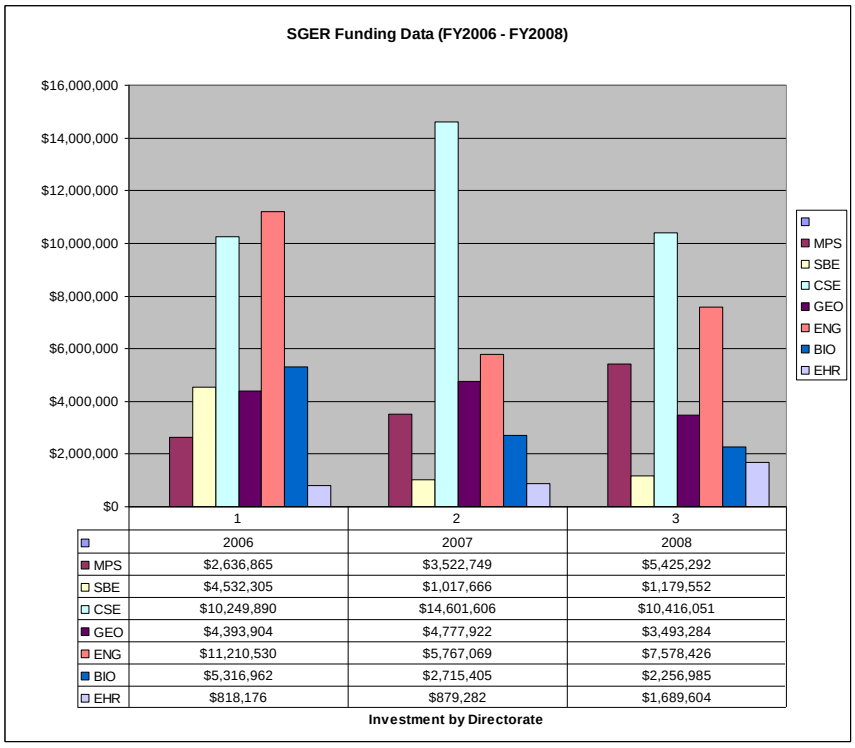
- One of the major concerns in the CCF CoV report was the organization of the visit itself. Information about the questions that the committee should address and data and explanations to support the COV's analysis were not provided to the committee prior to the

visit. Thus the committee members felt that they wasted a lot of time familiarizing themselves with the process and would have preferred to have more time for substantive discussions instead.

In response to this, we are providing much of the information ahead of the visit. We are also preparing this self-study report that provides a big picture of CISE and CCF activities over FYs '06-'08 and beyond, and provides data and corresponding analysis, where possible.

- The CoV also expressed concern that SGERs might be an inadequate mechanism for funding exploratory research both in size of awards and in duration. This concern has been raised throughout the agency's CoV process, and NSF recently responded along several dimensions. First, NSF revised its Intellectual Merit review criterion to better emphasize the agency's commitment to support transformative activities. Further, NSF (and CISE) revised guidance provided to reviewers to ensure reviewers are more aware of the agency's commitment to identify and support potentially transformative projects. Finally, NSF solicitations place more emphasis on transformative research than ever before.

  CISE has always used the SGER award mechanism generously. In FY '06, 2% of CISE obligations were directed to SGER awards (up from 1.4% in FY 2005) in comparison with the NSF average of 0.6%, and in FY '07, 2.7% of CISE obligations were directed to SGER awards in comparison with the NSF average of 0.6%. In FY '08, 2% of CISE obligations were directed to SGER awards in comparison with the NSF average of 0.5%. SGER awardees have really furthered their research with these awards. Several have gone on to submit top-rated CAREER and general competition proposals the year after their SGER award.



	1	2	3
	2006	2007	2008
MPS	$2,636,865	$3,522,749	$5,425,292
SBE	$4,532,305	$1,017,666	$1,179,552
CSE	$10,249,890	$14,601,606	$10,416,051
GEO	$4,393,904	$4,777,922	$3,493,284
ENG	$11,210,530	$5,767,069	$7,578,426
BIO	$5,316,962	$2,715,405	$2,256,985
EHR	$818,176	$879,282	$1,689,604

Table 2: NSF SGER Awards By Directorate

NSF replaced the SGER program with two new programs:

- the EArly-concept Grants for Exploratory Research (EAGER) provides up to $300,000 over two years, and supports "High Risk-High-Payoff" research. EAGER proposals do not need to be externally reviewed. Supplements and no-cost extensions are possible, consistent with NSF policy.
- Grants for Rapid Response Research (RAPID) provide funding for research with a severe urgency with regard to availability of, or access to data, facilities or specialized equipment. This includes quick-response research on natural and anthropogenic disasters and similar unanticipated events. Proposals are 2-5 pages long, external review is optional, and funding is provided at levels up to $200,000 for one year with supplements and no-cost extensions possible consistent with NSF rules.

Accordingly, CISE will vigorously promote the use of the EAGER and RAPID award mechanisms.

- The other main point made by the previous CoV was with regard to large grants. The committee expressed the hope that mechanisms would be provided to incentivize Program Directors to make larger awards.

  Over the last few years CCF and other Divisions within CISE have done this, in some cases leveraging ITR funds to match contributions made by individual programs. Many CISE programs now explicitly invite the submission of both individual and multi-investigator projects (at small, medium, large), and in FY 2008 CISE established the Expeditions program to support high-risk transformative research projects requiring investments up to $2 million/year for 5 years. CCF provides leadership for this program. These efforts are leading to an increase in the average award size, although not consistently across all programs, as will be evident in tables 4, 6, and 9 in this document. In FY 2006, the average annual research award grant in CISE was $142,000 and rose to $164,000 in FY 2008.

C. CCF Core Programs (FY '06 to FY '08)

For the period FY '06 to FY '08 - the period that this review covers - CCF supported three core programs: Theoretical Foundations (TF)***;*** Computing Processes and Artifacts (CPA); and Emerging Models and Technologies (EMT). These programs contribute to realization of NSF's Discovery strategic goal, and secondarily to the Learning strategic goal. **(**CCF also supported a larger number of special emphasis programs that are described in more detail in Section D.)

Notwithstanding its extensive participation in special emphasis programs, 60 – 70% of CCF's funds are used to fund research and education in the core programs. (CCF has further strengthened the emphasis on foundational work in FY '09 by paying close attention to the portfolio of awards and by increasing funding for areas such as Programming Languages, Architecture, Algorithms and Complexity, and Formal Methods.)

The core program research award portfolio closely tracks emerging trends nationally, even internationally. CCF considers identifying emerging scientific or societal trends and developing research that responds to them to be an essential component of the responsibilities of a Program Director.

C.1 Theoretical Foundations (TF) Program

a). Scientific Scope

The scientific scope of the TF program includes and spans the following areas:

- Communications: theory and techniques, as well as software and hardware, for the efficient representation, transmission and reception of digital and analog information over a variety of channels (e.g., wired, mobile multi-antenna wireless, optical, and biological channels)

- Computational Geometry: foundational work including the design and analysis of new geometrical algorithms, as well as the creation of software and tools for doing geometric computations.

- Numerical Computing and Optimization: advanced algorithmic and computational techniques and methods, as well as the development of basic mathematical tools and methods. This includes the design and construction of high quality computing software for scientific research and experimentation.

- Signal Processing Systems: signal processing algorithms, and supporting software and hardware systems that maintain signal processing as an enabling technology for information systems and as a catalyst for new technological and theoretical innovations.

- Symbolic and Algebraic computation: powerful methods for symbolically solving algebraic - numeric systems that combine differential, integral and polynomial equations.

- Theory of Computing: development of tools, techniques, and paradigms to understand the nature of computation - its inherent power and its limitations, where computation includes mathematical models of computation, human-designed computing on real computers, and computing occurring in nature or inspired by natural processes

The TF program also invited proposals in the Scientific Foundations for Internet's Next Generation (SING) during the review period:

- SING: Merging elements of the theoretical foundations of computing, communications, signal processing, and network science into a foundation for a clean-slate redesign of the Internet, SING was developed to challenge well-established theories and break barriers between research communities: theoretical and experimental, communications and computing, physical and network layers.

b). Program Team

The following individuals supported the TF program in FYs '06-'08

- John H. Cozzens, Program Director
- Robert Grafton, Program Director
- Kathleen O'Hara, Program Director
- Lenore Mullin, Program Director
- Eun Park, Program Director
- William Steiger, Program Director
- Sirin Tekinay, Program Director

- Dawn Patterson, Program Assistant
- Tracey Wilkinson, Program Analyst
- Joneka Thompson, Integrative Activities Specialist

c). Programmatic Data and Analysis

Table 3 below describes proposals submitted in response to the Theoretical Foundations program solicitation for Fiscal Years 2006, 2007 and 2008.

	Fiscal Year		
	2006	**2007**	**2008**
Number of TF Proposals Received	454	411	427
TF Research Proposal Funding Rate	20%	33%	34%
CISE Research Proposal Funding Rate	22%	24%	20%
NSF Research Proposal Funding Rate	21%	22%	21%

Table 3: Number of Proposals Received in Response to TF Solicitation, Resulting Proposal Funding Rates and CISE and NSF Proposal Funding Rates by Fiscal Year

The funding rate for TF proposals was slightly lower than both the CISE and NSF funding rates in FY '06. However, the funding rate for TF proposals in FY '07 and FY '08 rose significantly, and is now among the highest of all CISE and NSF programs.

The increase in funding rate resulted from a significantly higher budget allocation to TF in FY '07 and FY'08. This increase was the result of strong advocacy by the research community and a recognition in CISE that TF was significantly underfunded. Data describing the annual program budget, the number of competitive awards, and the annualized mean award size for the program are provided in Table 4 below.

Theoretical Foundations Program	Fiscal Year		
	2006	2007	2008
Annual Program Budget ($ M)	28.79	43.16	46.57
Number of Competitive Awards	91	137	147
Annualized Mean Award Size ($)	$93,591	$94,256	$91,443

Table 4: Annual Program Budget, Number of Competitive Awards, and Average Annual Award Size by Fiscal Year

The program budget increased by approximately 50% in FY 2007, the number of competitive awards increased by 80% and the average annual award size stayed relatively constant.

Funding rates for women were significantly higher than the overall funding rate, as indicated in Table 5 below. The rate for underrepresented minorities was lower than the overall rate in FY '06 and '07 but increased to above the overall rate in FY '08, but the small size of this group makes it difficult to draw useful conclusions. Use of EPSCOR funds and funding of EPSCOR state proposals has increased during the period of the review partly due to the expansion of the list of EPSCOR states.

Table 5 below indicates that new PIs were funded at lower rates than the overall funding rate in TF. This is the case across Directorates at NSF. Agency-wide new PIs also tended to send more proposals per capita, which was probably the case for PIs in TF as well.

In this and subsequent Demographic Data tables there may be an underreporting of the number of underrepresented minority PIs, because some PIs did not indicate their ethnicity.

Demographic Data			
TF	**2006**	**2007**	**2008**
Total # of PIs	454	411	427
Total # PIs Funded	91	137	147
TF Funding Rate	20%	33%	34%
# of New PIs	133	141	116
# of new PIs funded	16	35	31
Funding Rate New PIs	12%	25%	27%
Total # Male/Funded	390/80	342/111	353/118
Total # Female/Funded	64/11	69/26	74/29
Funding Rate Female	41%	38%	39%
EPSCOR Funded	1	13	12
Underrep. minorities/Funded:	32/4	24/4	24/9
Funding Rate for Underrep. minorities	13%	17%	38%
Underrepresented groups/Funded: includes total female and minority	96/15	93/30	98/38
Funding rate for underrep. groups	16%	32%	39%

Table 5: Demographic Data by Fiscal Year

C.2 Foundations of Computing Processes and Artifacts (CPA) Program

a). Scientific Scope

The scientific scope of the CPA program includes and spans the six areas described below:

- Software Design and Productivity: software engineering, programming languages, and evaluation methods and tools
- Computer Graphics and Visualization: algorithms for the modeling, rendering, and display of data, visual information transfer, representing and exploring non-visual information, and the development of 3D displays and graphics hardware.
- Computer System Architecture: processor microarchitecture and parallel processor architectures, memory, interconnection network, and I/O architectures, and application-specific and reconfigurable architectures
- Design Automation for Micro and Nano Systems: high-level design and synthesis of micro and nano systems including systems on chips etc., heterogeneous systems design including MEMs, NEMS, analog and mixed signal systems; and the modeling and simulation of micro and nano scale devices and architectures
- Advanced Computation Research: scalable and latency tolerant computational/numeric algorithms; management of large-scale distributed file systems and data; and software and hardware artifacts for design, simulation, benchmarking, tracing performance measurement, and tuning of I/O, file, and storage systems in high-performance computing environments
- Compilers and High-Performance Software: parallelizing compilers and infrastructure for optimizing compilers for multiple platforms, including reconfigurable architectures; parallelization techniques for exploiting parallelism at multiple levels applicable to multiple programming models; and software and compiler support for mapping and scheduling multiple threads on (possibly heterogeneous) multicore and multiprocessor systems; techniques for managing on-chip communication, power consumption, temperature, and fault tolerance

b). Program Team

The following individuals supported the CPA program in FYs '06-'08.

- Sankar Basu, Program Director
- Almadena Chtchelkanova, Program Director
- Chitaranjan Das, Program Director
- Sol Greenspan, Program Director
- Alan Hevner, Program Director
- Timothy Pinkston, Program Director
- Lawrence Rosenblum, Program Director
- Joseph Urban, Program Director

- Gwen Barber-Blount, Project Specialist (on detail)
- Laurin Battle, Student Trainee (Program Analyst)
- Willette Goodine, Integrative Activities Specialist
- Neila Odom, Project Specialist
- Allison Smith, Senior Program Assistant
- Charmain Woods, Program Analyst

c). Programmatic Data and Analysis

As indicated in Table 6 and 7 below, the CPA budget increased by approximately 7 % between FY '06 and FY '07. A significant increase in funding was effected in FY 2008 to reduce outyear obligations against the program so that an increasing emphasis on software is possible in FY 2009. Accordingly, the number of competitive awards made by the CPA program remained roughly constant through the period, while the annualized mean award size has increased slightly.

Computing Processes and Artifacts	Fiscal Year		
	2006	2007	2008
Annual Program Budget ($ M)	39.80	42.69	53.72
Number of Competitive Awards	110	120	111
Annualized Mean Award Size ($)	$95,318	$97,217	$106,368

Table 6: Annual Program Budget, Number of Competitive Awards, and Average Annual Award Size by Fiscal Year

The funding rates for proposals submitted in response to the CPA program solicitation are consistent with funding rates for research proposals in CISE and NSF, as indicated in Table 7 below.

	Fiscal Year		
	2006	2007	2008
Number of CPA Proposals Received	516	510	496
CPA Research Proposal Funding Rate	21%	24%	22%
CISE Research Proposal Funding Rate	22%	24%	20%
NSF Research Proposal Funding Rate	21%	22%	21%

Table 7: Number of Proposals Received in Response to CPA Solicitation, Resulting Proposal Funding Rates and CISE and NSF Proposal Funding Rates by Fiscal Year

The CPA program has paid significant attention to assuring that there is diversity among PIs and institutions. At the institutional level, the EPSCoR program, which provides co-funding for institutions in underrepresented states, is utilized. EPSCoR enables the program to obtain additional funds for proposals that are worthy but would not make the cut in the recent funding climate. CPA PDs increasingly sought to leverage CPA funding using EPSCoR, as can be seen in the growth in the table below. It should be noted that, with the expansion in recent years of states that are eligible for EPSCoR grants, the process does not always assure that funding goes to underrepresented institutes (e.g., institutions such as Brown University are now eligible for consideration). However, the EPSCoR institution list in the appendix demonstrates the diversity of institutions that CPA has funded under EPSCoR.

The CPA PDs also seek to ensure that women and minorities are well represented in CPA awards. This is done mainly at the individual program director level. However, during program meetings to discuss funding (and especially when additional funding becomes available at the end of the year), emphasis has been placed on funding worthy proposals from women and minorities. Funding rates for women again significantly exceeded the overall rate. Funding rates for underrepresented minorities remained below the overall rate. Again, the small size of this group makes it difficult to draw meaningful statistical conclusions.

Demographic Data			
CPA	2006	2007	2008
Total # of PIs	516	510	496

Total # PIs Funded	110	120	111
CPA Funding Rate	21%	24%	22%
# of New PIs	143	148	127
# of new PIs funded	26	19	16
Funding Rate New PIs	18%	13%	13%
Total # Male/Funded	441/89	431/94	411/88
Total # Female/Funded	75/21	79/26	85/23
Funding Rate Females	28%	33%	27%
EPSCOR Funded	9	6	10
Underrep. Minorities/Funded:	24/3	19/3	21/3
Funding Rate for Underrep. minorities	13/%	16%	14%
Underrepresented groups/Funded: includes total female and minority	99/24	98/29	106/26
Funding rate for underrep. groups	24%	30%	25%

Table 8: Demographic Data by Fiscal Year

C.3 Emerging Models and Technologies in Computation (EMT) Program

a). Scientific Scope

The scientific scope of the EMT program includes and spans the topical areas described below:

- Biological Systems Science and Engineering: research at the intersection of biology and computer science, with a specific focus on activities that advance understanding of computing and communication processes in biological systems in order to recreate or use them as models for, or demonstrations of, innovative silicon-based and bio-material based computing and communication systems.
- Quantum Information Science**:** research that explores disruptive innovations in computing and communication systems by drawing upon new insights and understanding

in Quantum Information Science, ultimately leading to the stronger unification of information sciences, quantum physics, and molecular biology.

- Nanotechnology for Computing and Communication: research that advances the physical design/realization of novel, nanoscale computing, communication and information processing models.

- Other Emerging Models and Technologies for Computing and Communication: innovative projects that apply other emerging models and technologies to create fundamentally new computing and communication systems.

b). Program Team

The following individuals supported the EMT program in FYs '06-'08.

- Mitra Basu, Program Director
- Pinaki Mazumder, Program Director
- Stephen Mahaney, Senior Science and Technology Advisor
- Tatsuya Suda, Program Director

- Kamilah Bossett, Student Trainee (Program Analysis)
- Crystal Champion, Project Specialist
- Velma Lawson, Integrative Activities Specialist
- Allison Smith, Senior Program Assistant

c). Programmatic Data and Analysis

As Table 9 below indicates, the annual budget allocation to EMT remained roughly constant over the review period. The spike in success rate in FY '08 resulted from a combination of factors: EMT was able to get some of its awards co-funded by other core programs in CCF as well as from other Directorates in NSF. In addition, low obligated amounts from prior years made possible the funding of many more new awards.

Emerging Models and Technologies	Fiscal Year

	2006	2007	2008
Annual Program Budget ($ M)	15.06	14.95	16.67
Number of Competitive Awards	34	32	66
Annualized Mean Award Size ($)	$108,909	$109,848	$145,509

Table 9: Annual Program Budget, Number of Competitive Awards, and Average Annual Award Size by Fiscal Year

The funding rates for proposals received in response to the EMT program solicitation for each of the fiscal years being reviewed are described in Table 10 below. Clearly, the funding rates are higher than in most CISE and NSF programs for all fiscal years under review. As indicated above, the funding rate was particularly high in FY 2008 because the program was able to attract significant co-funding from other CISE and NSF programs.

	Fiscal Year		
	2006	2007	2008
Number of EMT Proposals Received	102	109	148
EMT Research Proposal Funding Rate	33%	29%	45%
CISE Research Proposal Funding Rate	22%	24%	20%
NSF Research Proposal Funding Rate	21%	22%	21%

Table 10: Number of Proposals Received in Response to EMT Solicitation, Resulting Proposal Funding Rates and CISE and NSF Proposal Funding Rates by Fiscal Year

As in the other two programs there were significantly more EPSCOR-funded projects in FY '08 again for the same reasons. Funding rates for women tracked overall funding rates, while funding rates for underrepresented minorities were lower in FY '07 and FY '08. As in the other two programs, small sample sizes make it difficult to make reliable statistical conclusions.

Demographic Data			
EMT	**2006**	**2007**	**2008**
Total # of PIs	102	109	147
Total # PIs Funded	34	32	66
EMT Funding Rate	33%	29%	45%
# of New PIs	33	46	56
# of new PIs funded	11	12	21
Funding Rate New PIs	33%	26%	38%
Total # Male/Funded	79/25	93/29	129/58
Total # Female/Funded	22/9	15/3	18/8
Funding Rate Females	41%	20%	44%
EPSCOR Funded	1	2	8
Underrep. minorities/Funded:	8/3	4/1	6/2
Funding Rate for Underrep. minorities	38%	25%	33%
Underrepresented groups/Funded: includes total female and minority	30/12	19/4	24/10
Funding rate for underrep. groups	40%	21%	42%

Table 11: Demographic Data by Fiscal Year

d) Integration of Teaching and Research

EMT projects typically involve CISE PIs interacting with PIs from other disciplines such as biology, physics, or engineering. Special attention needs to be paid to the training of students at all levels, post-docs, and the PIs themselves. Participants get training in a number of disciplines, sometimes by taking existing courses in several departments. More often, they are trained on the job – group seminars, interactions with advisors and other students. Also out of necessity especially in EMT areas, new courses (bio/nano technology, quantum computing, computational biology) are introduced by PIs.

EMT actively supports projects on education. One such project - The Bio-Math Connection $2.5M/5 years # 0628091- was co-funded with EHR in 2006. This project housed at Rutgers trains High School teachers in the interdisciplinary areas of computer science, mathematics and biology.

D. Special Emphasis Programs - FY '06 to FY '08

Many special emphasis programs involving CCF were supported during the review period. The special emphasis programs contribute to NSF's strategic goals for **Discovery**, **Learning,** and **Research Infrastructure** as indicated below.

DISCOVERY Programs

- The Accelerating Discovery in Science and Engineering through Petascale Simulations and Analysis (PetaApps) program (FY'07, FY'09) was established in FY'07 to develop the future simulation, optimization and analysis tools that will allow researchers from many fields to use petascale computing to advance the frontiers of scientific and engineering research. In FY'07, 133 projects were received. Funded at a multi-directorate level of $27 million in FY'07, 18 projects were awarded. CCF provided $3 million to support new awards. The program is being run again in FY'09, see http://www.nsf.gov/pubs/2008/nsf08592/nsf08592.htm.

- The Cyber-Enabled Discovery and Innovation (CDI) program (FY'08 – present) is an NSF-wide program conceived originally by the SIGACT community as viewing other sciences and engineering through an algorithmic lens, as described in the workshop report, "The Computational Worldview and the Sciences: a Report on Two Workshops" by S. Arora, A. Blum, L. Schulman, A. Sinclair, and V. Vazirani published in October 2007 and available at http://www.cs.caltech.edu/~schulman/Workshops/CS-Lens-2/report-comp-worldview.pdf . The program has expanded to seek ideas applying innovative ***computational thinking*** to other sciences and engineering. In its first year (FY'08), this program was enormously popular drawing more than 1800 Letters of Intent and 1300 pre-proposals. Out of the 200 full proposal projects that were invited, ultimately 36 projects were funded, representing a diverse portfolio across all the directorates at NSF. NSF supported awards totaling approximately $48 million, with CCF providing $8 million and CISE providing a total of $18 million (including CCF's share). Dr. Sirin Tekinay from CCF was one of three co-chairs of the agency-wide working group who administered the program.

- The Expeditions program (FY '08- present) was established in FY '08 to support bold and ambitious ideas that require significant funding investments ($2 million/year for 5 years). The program received 122 Letters of Intent and 75 pre-proposals. 20 full proposal projects were invited. With an annual budget of approximately $30 million, the first competition resulted in four outstanding awards spanning the breadth of computer science and emerging interdisciplinary fields. http://www.nsf.gov/pubs/2007/nsf07592/nsf07592.htm. The link to the most recent

competition is at http://nsf.gov/funding/pgm_summ.jsp?pims_id=503169&org=CISE . Each of these $10 million grants will allow teams of researchers and educators to pursue far-reaching research agendas that promise significant advances in the computing frontier and great benefit to society http://www.nsf.gov/news/news_summ.jsp?cntn_id=112075. The Expeditions awards were funded from the ITR account in FY'08. Each of the funded projects has its own website that provides more detailed information on the project.
More information about the Expedition based at CalTech is available here: http://www.dna.caltech.edu/MPP/Docs/MPP_RSV_2008_public.ppt
More information about the Expedition based at Cornell is available here: http://www.cs.cornell.edu/gomes/computational-sustainability/
More information about the Expedition based at Stanford is available here: http://cleanslate.stanford.edu/pomi2020/
More information about the Expedition based at Princeton, Rutgers, NYU and Institute for Advanced Studies is available here: http://www.cs.rutgers.edu/~allender/draft.html

- The Foundations of Visual and Data Analytics (FODAVA) program (FY'08 – present) is supported by a partnership that includes the Department of Homeland Security (DHS), the Directorate of Mathematical and Physical Sciences (MPS) at NSF, and CISE. The program seeks ways to interactively visualize and glean knowledge from massive amounts of data using research ideas from data transformation and visualization, informed by cognitive psychology. In FY08, 37 proposals were received. 7 proposals were funded at a level of $2.25 million in FY'08, with CCF providing $750,000.

- The High-End Computing University Research Activity (HECURA) program (FY'06, FY'08)(http://www.nsf.gov/pubs/2006/nsf06503/nsf06503.htm) was created to address critical research issues in architecture, storage, software, and algorithms when computing with thousands (and even millions) of processors. The program involves DARPA, the three divisions in CISE and the NSF Office of Cyberinfrastructure (OCI). In FY'06, 21 out of 52 projects were funded. In FY'08, 19 out of 41 projects were funded. CCF invested approximately $10 million (ITR Funds) in the FY'06 and $10 million (including $6 million in ITR funds) in the FY'08 competitions.

- The Interactions between the Mathematical Sciences and Computer Science (MCS) program, (FY '03 – FY '07) recognizes the strong connections between computer science and the mathematical sciences and seeks to foster research on topics at the interface. In FY2006, 11 out of 54 projects were funded. In FY2007, 5 out of 25 projects were funded. The CCF budget for the program was $2-3 million annually but lower in FY '07, the terminal year of the first five-year program. The program has been renewed in FY '09 but at a reduced funding rate.

- The Nanoscale Science and Engineering (NSE) program (FY'06) is an NSF-wide program that seeks a better understanding of nature, the development of novel products, improved efficiency in manufacturing, sustainable development, better healthcare, and improved human performance through research and development of nanomaterials and nanotechnologies. The program was funded at levels of approximately $380 million, with CCF managing awards totaling approximately $12 million per year on the Nanoscale Science and Engineering initiative. CCF worked with the Engineering Directorate to support the National Nanotechnology Infrastructure Network (NNIN), an integrated partnership of thirteen user facilities providing unparalleled opportunities for nanoscience and

nanotechnology research. The network provides extensive support in nanoscale fabrication, synthesis, characterization, modeling, design, computation and hands-on training in an open environment available to all qualified users. CCF also co-funded Nanoscale Science and Engineering Centers (NSECs), Nanoscale Interdisciplinary Research Teams (NIRTs), and several small projects in the area.

- The Science of Design (SoD) program (FY'06 – FY'07) focused on projects that would bring creative, scientific advances to the design of software artifacts and systems.. The program was led by CCF, in collaboration with the two other CISE Divisions. 113 proposals were received in FY'06 and 37 proposals were funded. In FY'07, 120 proposals were received and 23 proposals were funded. The approximate annual funding level was $10 million and it was funded from the directorate's ITR account. A Science of Design PI Workshop was held on March 1 and 2, 2007 in Arlington, VA. A summary of the SoD Workshop can be found at http://www.cs.virginia.edu/~sullivan/SODPI07, and includes highlights of all SoD-funded projects.
- The Software for Real World Systems (SRS) program (FY'08) supports projects addressing the design of software-intensive systems for real-world systems in emerging contexts. The program was led by CCF in collaboration with the two other CISE Divisions. 169 proposals were received in this competition and 27 proposals were funded. The FY '08 budget for this program was $10 million (with CCF providing $10 million funded from the ITR account).

- CCF supports two Science and Technology Centers (STCs), each at an approximate annual level of $4 million:
  - the Center for Embedded Network Sensing (CENS) at the University of California, Los Angeles - http://research.cens.ucla.edu/. CENS is one of 6 Science and Technology Centers (STC) belonging to the Class of 2002 Centers (see http://www.nsf.gov/od/oia/programs/stc/)
  - the Team for Research in Ubiquitous Secure Technology (TRUST) at the University of California, Berkeley - http://www.truststc.org/. TRUST is one of 2 Science and Technology Centers (STC) belonging to the Class of 2005 Centers (see http://www.nsf.gov/od/oia/programs/stc/)

LEARNING Programs

- The Research Experience for Undergraduates (REU) program, is a long-term NSF-wide program that supports both sites and supplement awards that provide research experiences for undergraduates. CCF invests approximately $2 million in the program annually.

- Graduate Research Fellowships (GRFs) are not funded out of CCF, but support graduate students working on CCF-supported projects. CISE has underutilized the GRF program; far fewer applications come from CISE than from the Directorates of Engineering and Mathematical and Physical Sciences. By including information about this program as part of undergraduate research mentoring we hope to increase the number of applications and concomitantly, the number of awards to CISE.

- The Integrative Graduate Education and Research Training (IGERT) program is a long-term NSF-wide program that seeks to train scientists and engineers to address the global questions of the future. Through the use of innovative curricula and internships, and by

focusing on problem-centered training, these programs give their graduates the edge needed to become leaders in their chosen fields. NSF invests approximately $20 million annually in the program. While CCF contributes no funds directly, we do manage some of the awards.

- The CISE Pathways to Revitalized Undergraduate Computing Education (CPATH) program (with CNS as lead) focuses on K-12 education. There were 29 projects funded through $6M in CPATH funds and $5M in educational opportunity/special project funds.

RESEARCH INFRASTRUCTURE Programs

- The Computing Research Infrastructure (CRI) program (FY'06 – present) supports the research infrastructure needs of the computing community. Funded at an annual level of $18 million, CCF contributes no funds to the program but does manage awards relevant to the CCF community.

E. CCF Program Budgets

Within CISE, funding is allocated to the three Division accounts and to the ITR account each year. Funding allocated for FY's '06-'08 was described in Table 1 earlier.

Within the CCF division, funds were allocated to each of the core programs as described in Table 12 below.

	FY'06	FY'07	FY'08	% change over FY'06
TF	28.79	43.16	46.57	61.76
CPA	39.8	42.69	53.72	34.97
EMT	15.05	14.95	16.67	10.76

Table 12: Funding Levels for the Core Programs (dollars in millions)

Clearly, funding increased most significantly in the TF program, accounting for almost 62% increase over the review period. However, this table can be misleading because some CISE or CCF special emphasis programs augmented the core program budgets. For example, in FY '06, investments in the Science of Design program augmented CPA investments of $39.8 million by an additional $3.4 million and the High End Computing University Research Activity augmented CPA investments by $10 million. Similarly, in FY '08, the Software for Real World Systems program was funded from the ITR account at a level of $10 million and again augmented funding in the CPA program. A

significant budget increase was allocated to the CPA program in FY '08 to build a base for increased FY '09 and beyond core program investments in software research.

Table 13 below describes some of the larger CCF special emphasis program investments and links these investments with core program(s) of closest affinity.

	FY'06	FY'07	FY'08	Core Program Affinity
Research Experiences for Undergraduates Sites	1.02	1.32	1.7	TF, CPA, EMT
Foundations of Data and Visual Analystics			0.71	CPA
Science and Technology Centers	7.92	8	8	TF, CPA, EMT
Science of Design	3.424	4		CPA
Software for Real World Systems			9.94	CPA
High-End Computing University Research Activity	9.99	2.01	5.99	CPA
CyberTrust		0.57		TF, CPA, EMT
Nanoscale Science and Engineering	3.75	1.92	1.82	EMT
Biocomplexity in the Environment	1.5	0	0	CPA
Expeditions in Computing	0	0	16	TF, EMT
Cyber-enabled Discovery & Innovation			7.73	TF, CPA, EMT
TOTAL	22.354	17.82	44.16	

Table 13: CCF Investments in Special Emphasis Programs

(dollars in millions)

F. Proposal, Review, and Award Processes

CCF, like the rest of CISE, employs NSF's highly-regarded peer-review process in evaluating proposals. Most proposals are reviewed by a carefully-chosen panel of experts. PDs encourage panels to produce informative reviews and panel summaries. All proposals are evaluated on the two criteria developed by the National Science Board – Intellectual Merit and Broader Impacts. In some programs, for example Expeditions, additional criteria may apply. Panel recommendations are taken very seriously, however PDs occasionally make recommendations that run counter to those made by the panels. In such cases, review analyses provided by the PDs must provide clear justification for their action. PDs make every attempt to review interdisciplinary proposals appropriately, often through two or more panel reviews, or through additional *ad hoc* reviews. In such cases PDs exercise their judgment to make sure that a proposal doesn't get treated unfairly because its strengths are not fully recognized by any of the panels. Proposals that don't conveniently fit into a panel are sometimes reviewed by *ad hoc* mail reviews. In most cases, a proposal gets at least 4 reviews. Conflict of Interest (CoI) rules are strictly followed for both panel and *ad hoc* reviews.

Some programs have multi-stage review processes. For example, CDI in FY '08 had a three-stage process where investigators first sent Letters of Intent, followed by pre-proposals. The review process for pre-proposals is essentially the same as the process for proposal review. After this stage, some of the investigators submitting pre-proposals are invited to submit full proposals. In FY '09 CDI dropped the Letter of Intent stage. The Expeditions program for FY '08 also had a pre-proposal stage, and selected proposers were invited to submit full proposals. These proposals were reviewed in panel and a selected subset of these proposals was invited for a reverse site-visit. For each proposal on the short list, a team of PIs visited NSF and made presentations to another panel of experts. Panels are chosen so that their expertise is tailored to the proposals under review. Therefore, typically the panels for the different stages of the review process consist of different members. The size of the competition for CDI and the award sizes for Expeditions merit these more strenuous review processes.

Once a PD makes her/his recommendation, the proposal comes to the Division Director (DD) for her/his concurrence. The DD (or other NSF Scientific personnel nominated by the DD) reads through at a minimum, the Panel Summary, the Review Analysis, and the Reviews to determine if the decision needs to be reexamined. If so, the proposal is sent back to the cognizant PD who may obtain additional reviews or provide stronger justification for the recommended course of action.

The period from the receipt of a proposal (or the deadline for a solicitation) to the point when the DD concurs with the recommended action is called the *dwell time* of a proposal. NSF's customer service goal is to ensure that at least 70% of proposals submitted have a dwell time of less than 6 months. After the DD concurs, award processing is done by the Division of Grants and Awards (DGA).

Awards can be made as standard grants or continuing grants. There are clearly pros and cons to both funding modes. At CCF we have reduced our out-year obligations against continuing grants to less than 30% of our total annual budget. This strong financial position allows us to ride out one or two lean years in the future by borrowing more from the future to maintain funding levels. (NSF-wide, the goal is to have out-year obligations be no greater than 65% of the current year's budget, and we are far below that threshold.) Most importantly, having a modest out-year funding obligation allows us to be nimble in realigning our scientific funding priorities, as our field advances.

Each funded project is monitored by one or more PDs who review annual reports, decide on requests for REU or other supplements, and in some cases on early termination of the project because of non-performance. For larger awards such as the Expeditions and Science and Technology Center (STC) awards, annual site visits by NSF personnel are the norm.

G. Outcomes

Support of Early Career Research

In CCF the CAREER Award is a means to foster the career of "early" investigators and not a gate-keeping tool. We try to be especially thorough and helpful in the reviews and summaries we provide for declined CAREER proposals. Our CAREER funding rate has tracked the overall funding rate. CCF is acutely aware of the importance of the CAREER award for many early investigators at their institutions. In FY '09 we have made it a priority to fund all high-quality CAREER proposals without regard to the resulting funding rate.

More generally, we do not have the data to determine how long it takes a CCF investigator after her/his Ph.D. to get the first NSF award. NSF-wide there is some data available in the ARISE Report[1] written by the National Academy of Arts and Sciences This report finds that between 1990 and 2006 the average time-since-degree for first-time Principal Investigators at NSF increased from 8.5 to 9.3 years. The average age for a doctorate was 30-31 and thus the average age of first NSF award was 39 – 40 years.

Overall at NSF funding rates have declined between 1990 and 2006 from about 30% to about 21%. During the same period funding rates for new investigators declined from 22% to 15%. CISE funding rates fell from 34% in 1999 to 22% in 2008. CCF funding rates for new investigators are better than the NSF average and the CISE average.

	Fiscal Year		
	2006	2007	2008
Number of Career Proposals Received in CCF	207	213	149
CCF Career Proposals Funding Rate	22%	22%	31%
CISE Career Proposals Funding Rate	21%	24%	22%
NSF Career Proposals Funding Rate	16%	18%	18%

Table 14: Number of Proposals Received in Response to Career Solicitation, Resulting Proposal Funding Rates and CISE and NSF Proposal Funding Rates by Fiscal Year

Research Directions

TF has supported much of the work on compressive sensing and the related algorithmic field of streams and sketches. It has also funded foundational work tracking changing wireless and other communication technologies. It has expanded the reach of signal processing to include biological signals and communication. Communications/Information theory has funded projects on network coding and network information theory. TF has also supported the development of algorithms for tensor computations that are proving increasingly important in a variety of application areas.

The CPA program has recognized early the software and hardware challenges in moving to multicore platforms and, more generally, computing with very heterogeneous computers. It has supported the creation of new automatic tools for building multicore chips and encouraged the use of formal methods for both software and hardware verification. In graphics CPA funding has been crucial in the development of the exciting field of computational photography. The program has supported visualization research that goes beyond the visualization of scientific data to more general data. (The FODAVA program was launched to further encourage integrative research in this area.)

EMT was conceived to respond to emerging trends. For example, funding in nanoscale technologies is leading to nanoscale memories, targeted drug delivery, and new electronics. Investment in Quantum Information Science (QIS) is helping researchers to explore realization of quantum computer. The QIS research community is designing and analyzing algorithms that may one day revolutionize

search and cryptography. Funding in this area has produced considerable progress in the quantum communication front. Funding in the computational biology/biologically inspired computing continues to produce a deeper understanding of "how the living organisms function". Researchers supported by EMT are taking bold steps to reverse engineer biological organisms at all scales. Collaborative efforts between bio and nano researchers are leading to novel ways to self assemble computing models from nanoscale biological molecules.

For a more-detailed description of the core programs, see appendix A for program solicitations.

Diversity of PIs and Institutions: All three programs paid significant attention to assuring that there is diversity among PIs and institutions. At the institutional level, the EPSCoR program, which provides co-funding for institutions in underrepresented states, is utilized. EPSCoR enables us to obtain additional funds for proposals which are worthy but would not make the cut in the recent funding climate. With the expansion in the list of EPSCOR states our PDs have increasingly sought to leverage CCF funding using EPSCoR funds.

State	2006	2007	2008
Alabama	1	1	3
Arkansas	0	1	1
Delaware	0	4	2
Hawaii	0	1	0
Kansas	0	1	0
Kentucky	0	1	2
Louisiana	1	0	1
Maine	0	2	0
Mississippi	1	0	0
Nebraska	2	0	2
New Hampshire	0	1	0
New Mexico	4	3	8
Oklahoma	0	0	1

Rhode Island	2	3	3
South Carolina	0	1	3
South Dakota	0	1	0
Tennessee	0	1	2
West Virginia	0	0	2
Totals	11	21	30

Table 15: Demographic Data by Fiscal Year

also seek to ensure that women and underrepresented minorities are well represented in our awards. This is done mainly at the individual program director level. However, during program meetings to discuss funding (and especially when additional funding becomes available at the end of the year), emphasis has been placed on funding worthy proposals from women and minorities. Statistics on research support for women and underrepresented minorities in our core programs can be found in Section C.

Relevance to National Priorities

We categorize national priorities in the 06-08 period into national defense, American competitiveness, scientific and technological innovation, and leadership in science and engineering and describe below how CCF programs were relevant in each of these categories.

National defense:

Advances in software design and reliability and in computer systems architecture are essential for supporting critical computing infrastructure, which is crucial to the nation's economy and defense. Computer security and cryptography research helps safeguard this infrastructure. The Foundations of Data and Visual Analytics (FODAVA) program run jointly with the Department of Homeland Security seeks research that will allow intelligence analysts to visualize complex relationships in massive data sets in an interactive manner. CCF routinely collaborates with DoD and intelligence agencies to obtain additional funds to support the research community. One example is TF's collaboration with the CIA to provide supplements to support research on network tomography.

American Competitiveness:

Design automation advances are at the core of maintaining the U.S. competitive advantage in the design of commercial computer chips. Computer graphics and visualization advances help maintain industrial leadership in such key areas as computer-aided geometric design and entertainment.

Scientific and Technological Innovation:

Visualization methods support innovation across science, engineering and medicine. Quantum (under QIS) and nano computing (under Nanotechnology for Computing and Communication) support research efforts in finding viable technology and alternative/complementary computing models. The Nano Science and Engineering initiative and the National Nanotechnology Initiative support research on nanomaterials and nanotechnologies for a variety of applications.

Leadership in Science and Engineering:

Research on theoretical computer science provides novel computing solutions to difficult problems and helps us understand the theoretical limits of what is computable. For many problems a single algorithmic advance can provide greater speed-up than many generations of improvements in hardware and software. Research on programming languages and formal methods has led to great advances in producing "correct" software and hardware and a formal foundation for network security. Research in these areas, in architecture, and in high-end computing helps advance the design, deployment, and use of multicore processors and other non-traditional architectures. Advanced Computational Research (ACR) provides the tools that enable scientific computation to maintain US leadership across science and engineering areas. The Accelerating Discovery in Science and Engineering through Petascale Simulations and Analysis (PetaApps) program provides the University of Illinois – Urbana-Champaign with a powerful supercomputer for scientific computation that may advance studies in such areas as climate change. EMT supports research areas that have been identified as Grand Challenges for Engineering by the National Academies. For example, reverse engineering the brain, engineering better medicine and advancing health care informatics are supported under Biological Systems Science and Engineering (BSSE).

H. Looking Ahead

In the summer of 2008, CISE initiated three crosscutting programs that involve all three CISE divisions:

- Trustworthy Computing (TwC) is the intellectual heir of the Cyber Trust program that was housed in CNS. TwC embraces a broad research agenda that extends beyond security to include privacy, reliability, and usability of software and systems with a special emphasis on foundations of trustworthy computing.
- Network Science and Engineering (NetSE) seeks to foster research that focuses on new kinds of social and technological networks and on ideas that transcend the traditional layers of networks, network protocols, and networks research. NetSE subsumes the SING portfolio in CCF and other portfolios in the other two divisions.

- Data-Intensive Computing (DC) is concerned with storing and computing on massive and/or complex data sets, especially on large-scale data centers and program architectures.

CCF makes substantial investments in these programs and is actively involved in the proposal review and awards process.

In addition, in collaboration with the Directorate for Engineering CISE launched a new Cyber Physical Systems (CPS) program for FY'09 that also involves all three CISE divisions. The term "cyber-physical systems" refers to the tight conjoining of and coordination between computational and physical resources. Research advances in cyber-physical systems promise to transform our world with systems that respond more quickly (e.g., autonomous collision avoidance), are more precise (e.g., robotic surgery and nano-tolerance manufacturing), work in dangerous or inaccessible environments (e.g., autonomous systems for search and rescue, firefighting, and exploration), provide large-scale, distributed coordination (e.g., automated traffic control), are highly efficient (e.g., zero-net energy buildings), augment human capabilities, and enhance societal wellbeing (e.g., assistive technologies and ubiquitous healthcare monitoring and delivery).

CISE seeks to be completely transparent in the description of its programs and funding opportunities. However we recognize that it may sometimes be hard for investigators to find the right program to target. Our Program Directors are frequently able to redirect misplaced proposals to the right destinations, both for core and crosscutting submissions and across these categories. To facilitate this clearinghouse and to make the proposal submission process more tractable, for FY'09 CISE created a combined core solicitation and a combined crosscut solicitation. Proposals are categorized by the size of the requested award into Small, Medium, and Large. Deadlines for core programs in the three divisions, and the three intra-CISE crosscuts are only a function of the requested award size. Having a combined solicitation allows us to find the right home for proposals without hurting our dwell time statistics.

CCF realigned its programmatic structure in the summer of 2008, with the new structure taking effect in FY '09. There were several goals in this realignment.

The foremost was to group together intellectually close areas so that the taxonomy within NSF would make sense and correspond roughly to how university departments view themselves.

The second goal was to give greater prominence to the broad area of algorithms and complexity, encompassing not only theory, but also algorithms applied to many areas of science and engineering as well as the empirical study of sequential and parallel algorithms.

We defined three new core programs:

- ***Algorithmic Foundations (AF)***
- ***Communication & Information Foundations (CIF)*** and
- ***Software and Hardware Foundations (SHF)***

The renaming helps put the focus on hardware and software – two core areas in computer science – and represented a slight shift in focus towards the foundational aspects of these areas. Thus we place greater emphasis on formal methods for both software and hardware, and distinguished programming languages from software engineering and formal methods.

Software has always been a high priority for CISE and CCF but it has risen to an even higher priority! Reliable, efficient, usable software, programming languages and environments for heterogeneous computing platforms ranging from multicore, to high-performance computing platforms, to platforms on non-silicon substrates remains a daunting challenge. Recognizing this, CISE sent out a Dear Colleague Letter titled "Rethinking Software", asking for radically new ideas that drew from other disciplines. This broader push on software involves all three Divisions, with CCF especially focused on foundational aspects. Some software proposals can also find homes in crosscutting programs such as Trustworthy Computing and Cyber Physical Systems.

In Algorithmic Foundations we included two elements from the EMT program – quantum computation and computational biology (where computational biology" refers to the use of algorithmic tools for solving problems in biology.) The related area of Bioinformatics, dealing with biological data and databases resides in IIS. The biocomputing and nanocomputing portfolios in the EMT program were placed in the SHF program. ("Biocomputing" includes building computing machines out of biological and biochemical processes and to bio-inspired computing, the attempt to mimic the computational approaches of biological systems in technological systems.)

While the Graphics and Visualization program was housed in the CPA program until FY '08, the area itself has been covered by many parts of CCF and IIS. In fact, computational geometry was supported in the TF program in CCF and algorithms for graphics and vision, visualization, and human-computer interfaces were supported in IIS as well as CCF. This led to some confusion in the community and not a full appreciation of the extent to which NSF supports the area. To remedy this we created a "virtual program" involving the PDs from both divisions covering all aspects of graphics and visualization. We wrote a Dear Colleague Letter to the community advertising this and asking them to send all graphics proposals to one program in IIS and all visualization proposals to another program, also in IIS. These proposals will be processed by the team of PDs forming this virtual program and the funding will come from a common account that has been allocated roughly the total amount that was spent on graphics and visualization in FY '08. Computational geometry remains in the Algorithmic Foundations program in CCF because of its intellectual affinity to other areas of Algorithms and Complexity.

The future for CCF looks very good. The current CISE Administration is strongly committed to supporting foundational research across the breadth of CCF. CCF has seen substantial increases in its budget for FY '08 and in the budget request for FY '09. In FY '09 CCF actually saw a decline in the number of proposals submitted to the core. Years of low success rates for funding in foundational areas have caused some researchers to modify their research programs and turn away from core CCF programs. The news from CCF is that it is time to reverse this trend. The Division will continue to be well-funded in the immediate future. Our future-year obligations are low, making it possible to ensure good success rates in new competitions. CCF is also forging strategic partnerships with other Divisions in CISE, with other Directorates, and other agencies to leverage its funding to support interdisciplinary research.

Our highest priority and biggest challenge continues to be the recruitment of high-quality Program Directors. With great effort we have had some good successes in the recent past hiring Mitra Basu (from Johns Hopkins and the Naval Academy) to run Computational Biology and the Expeditions Program, Dmitry Maslov from the University of Waterloo in Quantum Computing and Communication, Lenore Zuck from the University of Illinois, Chicago for Formal Methods and Program Analysis, and Bill Tranter from Virginia Tech for Communications. However, since most IPAs depart after a two to three year term, we are constantly looking to hire new people. We need the help of service-minded researchers, the general community, and university and research lab officials. This is a good time to be a program director in CCF!

Appendix A –Program Solicitations

Links to TF Program Solicitations for FY2006 – FY2008

http://www.nsf.gov/pubs/2006/nsf06542/nsf06542.txt

http://www.nsf.gov/pubs/2007/nsf07525/nsf07525.txt

http://www.nsf.gov/pubs/2008/nsf08518/nsf08518.txt

Links to CPA Program Solicitations for FY2006 – FY2008

http://www.nsf.gov/pubs/2005/nsf05576/nsf05576.txt

http://www.nsf.gov/pubs/2007/nsf07587/nsf07587.txt

http://www.nsf.gov/pubs/2007/nsf07587/nsf07587.txt

Links to EMT Program Solicitation for FY2006 – FY2008

http://www.nsf.gov/pubs/2005/nsf05626/nsf05626.txt

http://www.nsf.gov/pubs/2007/nsf07523/nsf07523.txt

http://www.nsf.gov/pubs/2008/nsf08517/nsf08517.txt

Appendix B: Proposal Review Data by Program for Fiscal Years FY2006 – FY2008

Average Score Legend

Rating	Score
Poor	1.0
Fair	2.0
Good	3.0
Verg Good	4.0
Excellent	5.0
Remarks	R

TF Program

FY	Proposal/Reviewer Data	AWD	DECL	Grand Total
2006	Number of Proposals	91	363	454
	Average of # of Reviews	5.18	4.98	
	Average of Average Score	4.10	3.04	
	Average of Reviews that Met Both Criteria	3.67	3.29	
	# of Panels	0	0	28
2007	Number of Proposals	137	274	411
	Average of # of Reviews	5.26	5.07	
	Average of Average Score	3.90	2.91	
	Average of Reviews that Met Both Criteria	3.61	3.43	
	# of Panels			21

2008	Number of Proposals	147	280	427
	Average of # of Reviews	4.69	4.68	
	Average of Average Score	3.98	2.82	
	Average of Reviews that Met Both Criteria	3.32	3.28	
	# of Panels			17
	Total Number of Proposals	376	919	1,292
	Total # of Panels			66

Table 16: Proposal Review Data for TF Program

CPA Program

FY	Proposal/Reviewer Data	AWD	DECL	Grand Total
2006	Number of Proposals	110	406	516
	Average of # of Reviews	5.26	5.06	
	Average of Average Score	3.96	2.95	
	Average of Reviews that Met Both Criteria	3.73	3.50	

	# of Panels	0	0	19
2007	Number of Proposals	120	390	510
	Average of # of Reviews	5.6	5.26	
	Average of Average Score	3.94	2.89	
	Average of Reviews that Met Both Criteria	4.17	3.84	
	# of Panels			23
2008	Number of Proposals	111	385	496
	Average of # of Reviews	5.51	5.22	
	Average of Average Score	3.80	2.81	
	Average of Reviews that Met Both Criteria	4.14	3.84	
	# of Panels			19
	Total Number of Proposals	343	1,184	1,522
	Total # of Panels			61

Table 17: Proposal Review Data for CPA Program

EMT Program

FY	Proposal/Reviewer Data	AWD	DECL	Grand Total
2006	Number of Proposals	34	67	101
	Average of # of Reviews	5.12	5.12	
	Average of Average Score	4.08	2.78	
	Average of Reviews that Met Both Criteria	3.79	3.91	
	# of Panels	0	0	3
2007	Number of Proposals	32	76	108
	Average of # of Reviews	4.84	4.81	
	Average of Average Score	4.09	2.87	
	Average of Reviews that Met Both Criteria	3.56	3.45	
	# of Panels			5
2008	Number of Proposals	66	81	147
	Average of # of Reviews	4.67	5.10	
	Average of Average Score	3.80	3.81	
	Average of Reviews that Met Both Criteria	3.32	3.28	
	# of Panels			5
	Total Number of Proposals	132	225	356
	Total # of Panels			13

Table 18: Proposal Review Data for EMT Program

Appendix C: Reviewer Demographic Data by Program for Fiscal Years FY2006 – FY2008

TF

Reviewer Demographic Summary

* Each reviewer was counted once per year per program by competition

Minority				
Fiscal Yr	**No**	**Yes**	**Not Reported**	**Grand Total**
FY06	137	8	221	366
FY07	86	5	123	214
FY08	79	7	108	194

Gender					
Fiscal Yr	**Female**	**Male**	**Unknown**	**Not Reported**	**Grand Total**
FY06	19	123	3	221	366
FY07	12	76	3	123	214
FY08	17	66	3	108	194

Disability					
Fiscal Yr	**No**	**Unknown**	**Yes**	**Not Reported**	**Grand Total**
FY06	91	51	3	221	366

FY07	67	22	2	123	214
FY08	61	22	3	108	194

Table 19: Reviewer Demographic Data for TF Program

CPA

Reviewer Demographic Summary

* Each reviewer was counted once per year per program by competition

Minority				
Fiscal Yr	**No**	**Yes**	**Not Reported**	**Grand Total**
FY06	90	4	158	252
FY07	111	9	139	259
FY08	106	8	120	234

Gender					
Fiscal Yr	**Female**	**Male**	**Unknown**	**Not Reported**	**Grand Total**
FY06	19	73	2	158	252
FY07	18	98	4	139	259
FY08	13	98	3	120	234

Disability					
Fiscal Yr	**No**	**Unknown**	**Yes**	**Not Reported**	**Grand Total**
FY06	61	29	4	158	252
FY07	95	23	2	139	259
FY08	85	27	2	120	234

Table 20: Reviewer Demographic Data for CPA Program

EMT

Reviewer Demographic Summary

* Each reviewer was counted once per year per program by competition

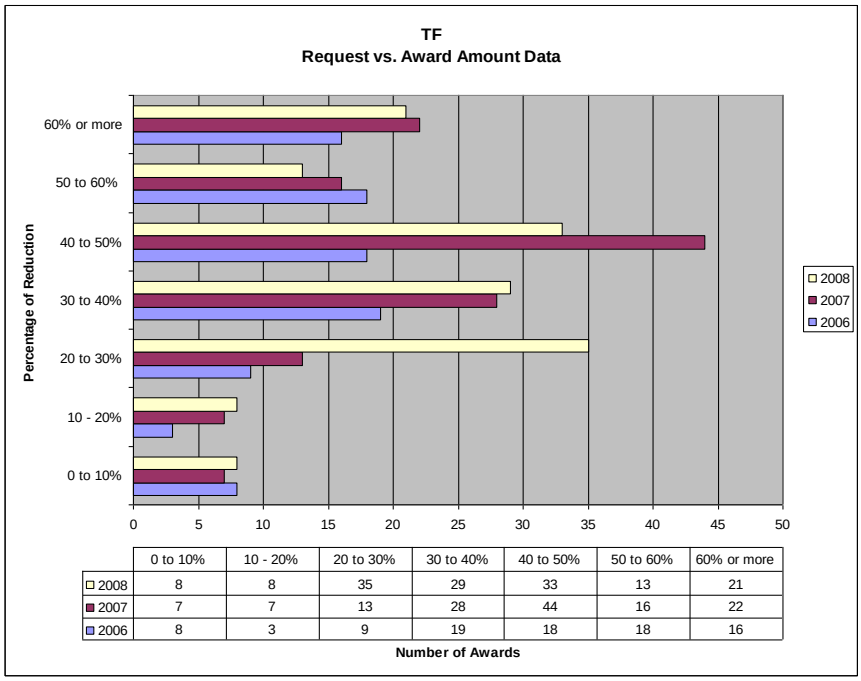
Minority				
Fiscal Yr	**No**	**Yes**	**Not Reported**	**Grand Total**
FY06	26	0	28	54
FY07	30	1	44	75
FY08	21	1	41	63

Gender					
Fiscal Yr	**Female**	**Male**	**Unknown**	**Not Reported**	**Grand Total**
FY06	3	22	1	28	54
FY07	3	26	2	44	75
FY08	2	20	0	41	63

Disability					
Fiscal Yr	**No**	**Unknown**	**Yes**	**Not Reported**	**Grand Total**
FY06	23	3	0	28	54
FY07	20	10	1	44	75
FY08	17	5	0	41	63

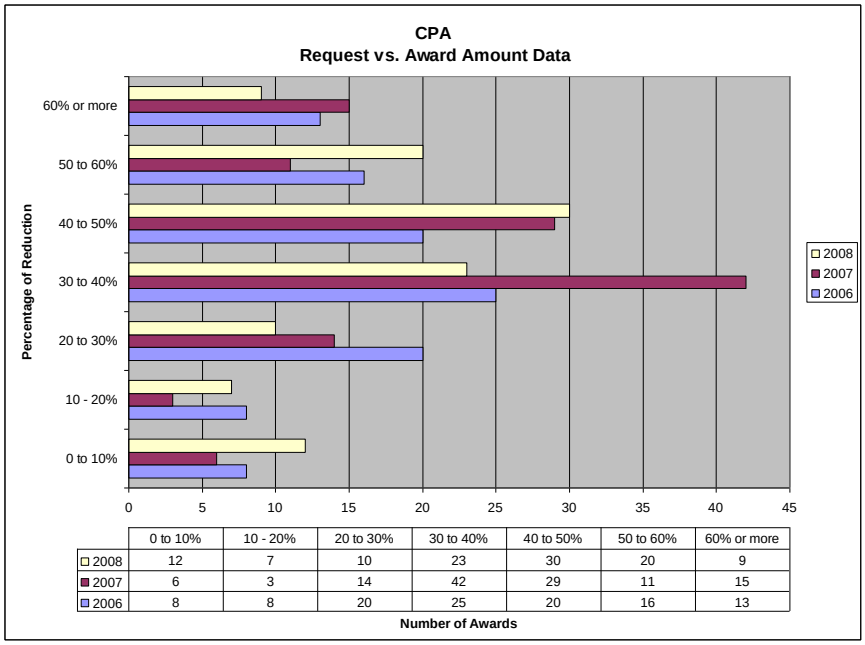
Table 21: Reviewer Demographic Data for EMT Program

Appendix D: Request vs. Award Amount Data for Fiscal Years FY2006 – FY2008



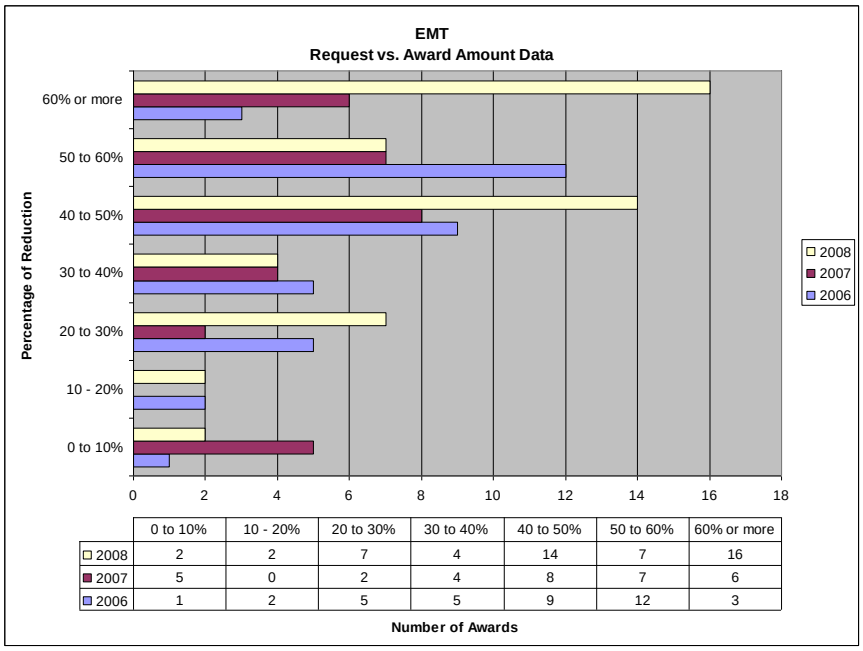
	0 to 10%	10 - 20%	20 to 30%	30 to 40%	40 to 50%	50 to 60%	60% or more
2008	8	8	35	29	33	13	21
2007	7	7	13	28	44	16	22
2006	8	3	9	19	18	18	16

Table 22: Request vs. Award Amount Data for TF Program



	0 to 10%	10 - 20%	20 to 30%	30 to 40%	40 to 50%	50 to 60%	60% or more
2008	12	7	10	23	30	20	9
2007	6	3	14	42	29	11	15
2006	8	8	20	25	20	16	13

Table 23: Request vs. Award Amount Data for CPA Program



	0 to 10%	10 - 20%	20 to 30%	30 to 40%	40 to 50%	50 to 60%	60% or more
2008	2	2	7	4	14	7	16
2007	5	0	2	4	8	7	6
2006	1	2	5	5	9	12	3

Table 24: Request vs. Award Amount Data for EMT Program

Appendix E: Number of Single vs Multi-investigator Awards for Fiscal Years 2006 - 2008

TF Summary

	# of Single Investigators	2 PIs	3 PIs	4 PIs	5 PIs
Fiscal 06	71	17	3	0	0
Fiscal 07	109	24	4	0	0
Fiscal 08	114	26	7	0	0

Table 25: Single vs Multi-investigator Awards Data for TF Program

CPA

	# of Single Investigators	2 PIs	3 PIs	4 PIs	5 PIs
Fiscal 06	72	28	7	3	0
Fiscal 07	79	28	13	0	0
Fiscal 08	71	31	9	0	0

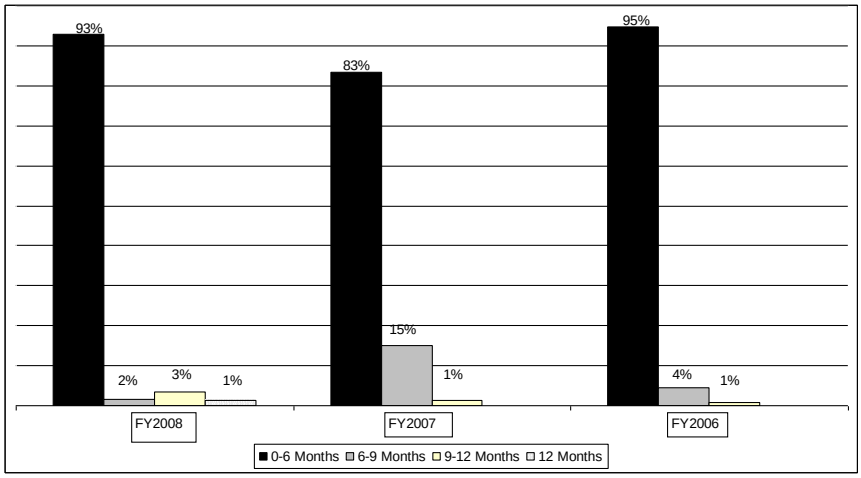
Table 26: Single vs Multi-investigator Awards Data for CPA Program

EMT					
	# of Single Investigators	**2 PIs**	**3 PIs**	**4 PIs**	**5 PIs**
Fiscal 06	17	13	2	2	0
Fiscal 07	18	9	3	2	0
Fiscal 08	43	13	5	2	3

Table 27: Single vs Multi-investigator Awards Data for EMT Program

Appendix F: Dwell Time Data

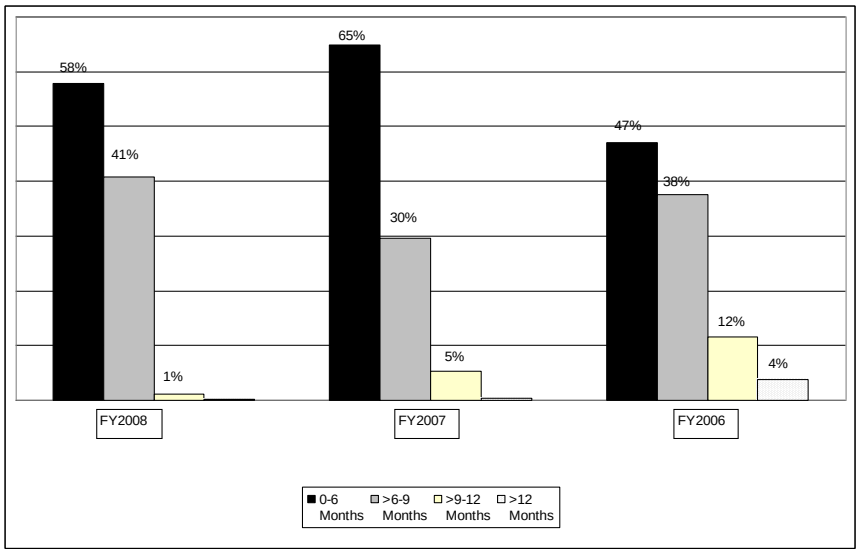
Dwell Time Data for FY2006 - FY2008



Fiscal Yr	Number of Proposals	Average Months	Standard Deviation	0-6 Months	6-9 Months	9-12 Months	12 Months
2008	505	4.66	1.65	93%	2%	3%	1%
2007	767	5.50	1.11	83%	15%	1%	0%
2006	299	4.00	1.50	95%	4%	1%	0%

* Data is based on number of proposals processed within the fiscal year

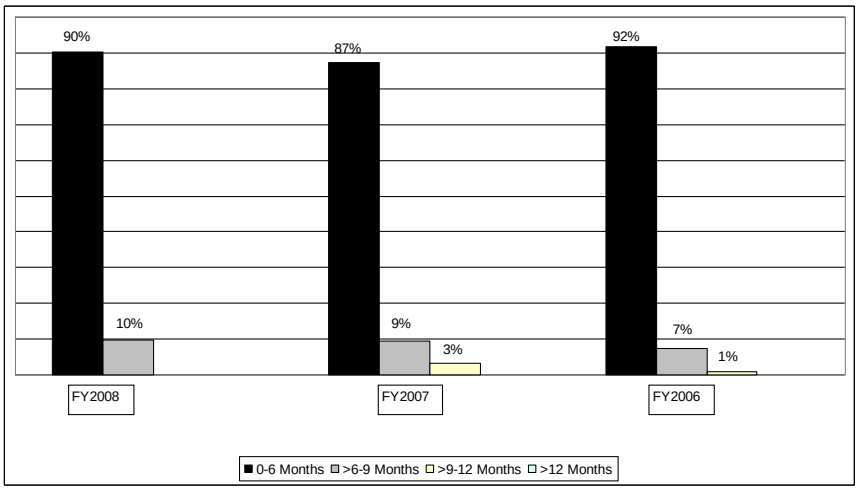
Table 28: Dwell Time Data for TF Program



FY	Number of Proposals*	Average Months	Standard Deviation	0-6 Months	>6-9 Months	>9-12 Months	>12 Months
2008	598	6.08	1.64	57.9%	40.8%	1.2%	0.2%
2007	629	6.23	1.70	64.9%	29.6%	5.2%	0.3%
2006	630	6.89	2.09	47.%	37.6%	11.6%	3.8%

* Data is based on number of proposals processed within the fiscal year

Table 29: Dwell Time Data for CPA Program



FY	Number of Proposals	Average (Months)	Standard Deviation (Months)	0-6 Months	>6-9 Months	>9-12 Months	>12 Months
2008	164	4.85	1.04	90%	10%	0%	0%
2007	118	5.41	1.47	87%	9%	3%	0%
2006	121	5.37	1.42	92%	7%	1%	0%

* Data is based on number of proposals processed within the fiscal year

Table 30: Dwell Time Data for EMT Program

Appendix G: Total Number of Actions by Core Program for FY2006 – FY2008

TF

TOTAL ACTIONS	2006	2007	2008
New Project	510	405	426
# of Proposals Received	520	436	481
Supplement	17	21	31
Renewal	6	6	6
Accomplished Based Renewal	0	1	0
Forward Fund	3	3	13
Proposal has been awarded	91	137	149
Decline, DD Concurred	366	274	283
Returned without Review	2	2	1
Pending actions	0	0	11
Transfers	3	2	0
Withdrawn	58	21	37
Continuing Projects	99	74	78

Table 31: Total Actions forTF Program

CPA

TOTAL ACTIONS	2006	2007	2008
New Project	532	528	512

# of Proposals Received	540	532	516
Supplement	38	10	4
Renewal	3	3	3
Accomplished Based Renewal	0	1	1
Forward Fund	0	9	90
Proposal has been awarded	114	121	111
Decline, DDConcurred	405	393	385
Returned without Review	5	2	3
Pending Actions	0	0	0
Transfers	5	2	0
Withdrawn	11	14	17
Continuing Projects	92	49	30

Table 32: Total Actions forCPA Program

EMT

TOTAL ACTIONS	2006	2007	2008
New Project	111	110	152
# of Proposals Received	116	112	153
Supplement	10	6	7
Renewal	5	2	1
Accomplished Based Renewal	0	0	0
Forward Fund	0	2	10
Proposal has been awarded	35	32	66
Decline, DDConcurred	67	77	82
Returned without Review	4	0	1
Pending Actions	0	0	0
Transfers	2	0	0
Withdrawn	8	3	4
Continuing Projects	65	56	18

Table 33: Total Actions forEMT Program

Proposal Load Data

* Counts include core and cross cutting programs

FY06

PD	# of Proposals	# Other Actions
ACHTCHELKANOVA	139	22
EPARK	27	2
JCOZZEN	94	10
KOHARA	11	3
LROSENBLUM	99	3
MBASU	127	19
RGRAFTO	61	12
SBASU	190	12
SGREENSPAN	250	32
SMAHANEY	5	2
STEKINA	71	1
TPINKSTON	128	17
WSTEIGE	66	2
TOTAL	1268	137

FY07

PD	# of Proposals	# Other Actions
PMAZUMDER	90	12
TSUDA	28	1
SGREENSPAN	101	32
ACHTCHELKANOVA	115	22
TPINKSTON	113	12
AHEVNER	66	1
JURBAN	84	0
LROSENBLUM	89	8
SBASU	184	18
EPARK	74	15
JCOZZEN	158	22
RGRAFTO	76	6
STEKINA	318	3
LMULLIN	39	2
WSTEIGE	154	0
RBEIGEL	48	9
TOTAL	1737	57

FY08

PD	# of Proposals	# Other Actions
PMAZUMDER	118	14
TSUDA	49	2
SGREENSPAN	109	35
ACHTCHELKANOVA	166	37

TPINKSTON	21	44
AHEVNER	218	9
JURBAN	58	2
LROSENBLUM	94	0
SBASU	158	36
CDAS	97	25
EPARK	53	8
JCOZZEN	136	26
RGRAFTO	41	6
STEKINA	159	47
LMULLIN	70	4
RBEIGEL	111	22
TOTAL	1658	317

Appendix I: Funding Data for FY2006 – FY2008

CISE Funding to Divisions

	FY05	FY'06	FY'07	FY'08	% change over FY'06
CCF	91.29	105.3	122.76	143.63	36.4
CNS	132.17	141.07	162.77	174.16	23.5
IIS	92.31	103.78	119.26	139.33	34.3
ITR	174.43	146.2	121.89	78.14	-46.6
Total	490.2	496.35	526.68	535.26	7.8

Percentage of CISE Funding to Divisions

Division	FY06	FY07	FY08	FY09
CCF	19%	21%	23%	27%
CNS	27%	28%	31%	33%
IIS	19%	21%	23%	26%

Division of Computing & Communication Foundations
Committee of Visitors for 2006-2008

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